

PUBLIC HEALTH REPORTS

In this issue

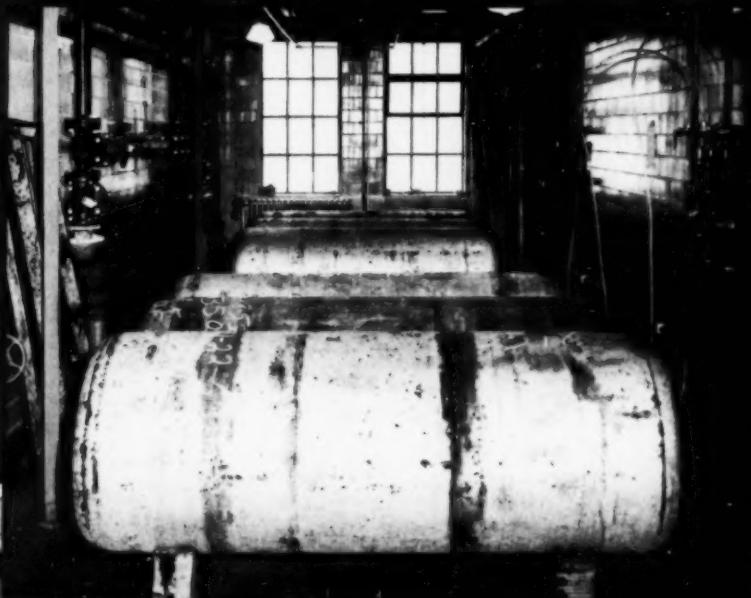
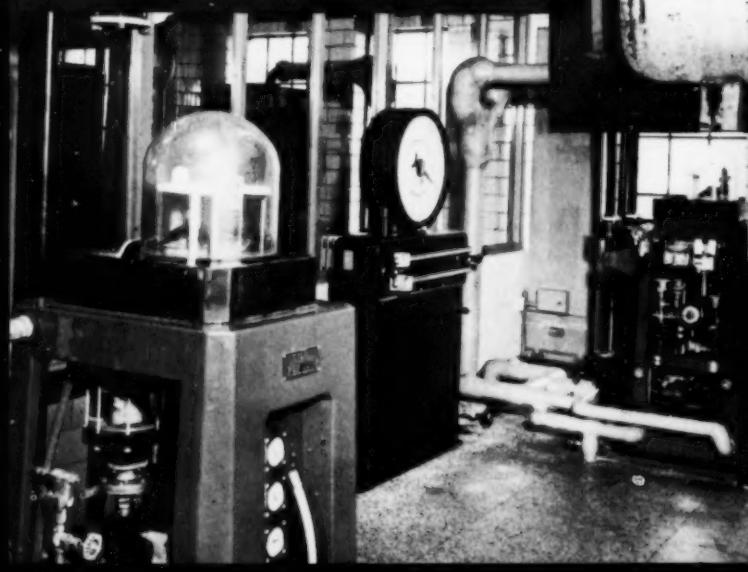


U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service



Water Filtration Plant

Milwaukee, Wisconsin



see overleaf

PUBLIC HEALTH REPORTS

Published since 1878

Contents

	Page
Leprosy in the United States----- <i>L. F. Badger.</i>	525
1954 summary of disease outbreaks----- <i>C. C. Dauer and Granville Sylvester.</i>	536
Bactericidal efficiency of Q.A.C. in different waters----- <i>Cecil W. Chambers, Paul W. Kabler, Alton R. Bryant, Leslie A. Chambers, and Morris B. Ettinger.</i>	545
An experience in home injury prevention----- <i>Harry Wain, Harold E. Samuelson, and F. M. Hemphill.</i>	554
Nutrition at the shopping center----- <i>W. H. Sebrell, Jr.</i>	561
Practical problems in rabies control-----	564
A time study method for public health—The Yale study----- <i>Edward M. Cohart and William R. Willard.</i>	570
Program distribution of working time in health departments—The Yale study----- <i>Edward M. Cohart and William R. Willard.</i>	577
European approaches to aging----- <i>Wilma Donahue and Clark Tibbitts.</i>	581
Observations on rats in an enzootic plague region of Hawaii----- <i>Leo Kartman and Richard P. Lonergan.</i>	585
St. Elizabeths centennial----- <i>Winfred Overholser.</i>	594
The world on a string—A mental patient's views on television-----	596

Continued ►

Milwaukee Filtration Plant

The water purification plant, owned and operated by the City of Milwaukee, is located on the west shore of Lake Michigan at the north end of Lake Park and directly east of Linwood Avenue. The site is on land reclaimed from Lake Michigan and occupies approximately 26 acres.

The purification plant is of the mechanical or rapid sand type. It has a capacity of 200 million gallons per 24 hours at a filtering rate of 2 gallons per square foot per minute. There are 32 filters, each having a capacity of 6.25 million gallons per day. When operated at the 200 m.g.d rate, there is 1 hour for mixing and 4 hours for settling.

Shown on the frontispiece are the exterior of the filter plant, a view of the ton containers of chlorine, and two of the chlorine feeding machines.

Contents for June, continued

	<i>Page</i>
The health maintenance clinic program of the Fife-Hamill Memorial Health Center----- <i>Gulden Mackmull, Hyman Menduke, and Joseph J. Cava.</i>	598
Self-purification of the soft clam, <i>Mya arenaria</i> ----- <i>William Arcisz and C. B. Kelly.</i>	605
 Short reports and announcements:	
Milwaukee filtration plant----- (Frontispiece)	ii
International conference on arid lands-----	535
Housing rehabilitation in disasters-----	563
Child health standards for paint-----	580
PHS staff announcements-----	597
Legal note on procedural due process-----	604
PHS films-----	614
Technical publications-----	615



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Data on patients admitted to the National Leprosarium at Carville, La., show that leprosy in the United States is concentrated in a few areas of a few States. Nevertheless, the disease may appear in any section of the country.

Leprosy in the United States

By L. F. BADGER, M.D.

THE EARLIEST available reference to leprosy in the United States is found in Romans' Concise Natural History of East and West Florida, which reports the occurrence of the disease in that area as early as 1758(1). By 1766, the disease was sufficiently prevalent to cause the Spanish commissioner of Louisiana to establish a leprosarium near the mouth of the Mississippi River. From this evidence, it may be assumed that leprosy has existed in this country for at least 200 years.

The disease has been reintroduced frequently since its first appearance; primarily from Europe and Africa during the early years; later, from Asia; and, since the acquisition of extra-territorial possessions, from the Caribbean and Pacific islands.

The prevalence of leprosy in the United States, past or present, is difficult to determine. Many cases have not been recognized, and some cases known to physicians have not been reported. No nationwide case-finding program

has ever been conducted. However, an idea of the number of cases in recent years can be obtained from the records of the National Leprosarium at Carville, La. From the opening of that institution in early 1921 through 1953, 1,465 individual patients were admitted. One or more patients were admitted from 40 States and the District of Columbia (fig. 1). Thus, the disease may appear in any section of the country. (The State from which admitted was not recorded for four patients.)

Of the 1,465 patients, 637 (43.5 percent) were foreign born and 822 (56.1 percent) were American born. The birthplace of six patients is not known. Generally, throughout the 33-year period, the number of American-born patients exceeded the number of foreign-born patients (fig. 2). (As used in this report, foreign born applies to patients born outside continental United States, and American born, to patients born within continental United States.)

Most of the patients, 1,204 (82.4 percent), were admitted from the States of New York, Florida, Louisiana, Texas, and California. From Florida, Louisiana, Texas, and California, States in which the disease has been considered endemic, 1,046 (71.6 percent) were admitted. (Although leprosy is no longer held to be endemic in California, for the purpose of this review California is classed as it was in the past.) The majority of the California pa-

Dr. Badger since 1949 has been chief of the Leprosy Control Unit, Communicable Disease Center, Public Health Service, Atlanta, Ga. In most of his assignments during his 24-year career with the Service he has been concerned with leprosy investigation and control work.

Figure 1. States from which patients were admitted to the National Leprosarium, 1921-53.



tients (80.6 percent) and of the New York patients (89.2 percent) were of foreign birth. The majority of the Florida patients (86.2 percent), of the Louisiana patients (95.4 percent), and of the Texas patients (74.8 percent) were born in the United States (table 1).

From 1940 through 1953, 476 patients were admitted to the leprosarium, as compared to 486 for 1931-40 and 503 for 1921-30. These figures suggest a slight downward trend. The decrease may be attributed in part, however, to the fact that in recent years patients with tuberculoid leprosy have not always been admitted to the leprosarium. The decrease is accounted for largely by a decrease in the number of foreign-born patients.

In addition to the patients admitted to the National Leprosarium, information has been obtained on 355 leprosy patients in the four endemic States who were not admitted. The number of patients in other States who were not admitted is at present unknown. Thus, a total of 1,820 patients were either admitted to the leprosarium or were known to have the dis-

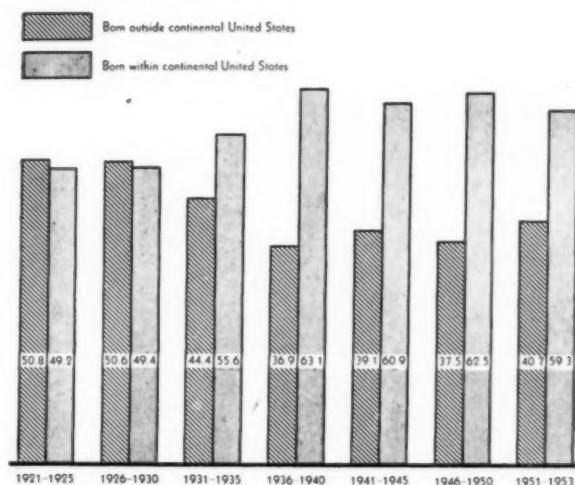
ease during the period 1921-53. It is impossible, however, to state with any degree of accuracy the total number of cases that actually occurred during that period.

Foreign-Born Patients

The 637 foreign-born leprosy patients admitted to the National Leprosarium give an idea of the extent to which leprosy has been imported into the United States in recent years. The majority of these patients probably became infected before they entered this country, and some of them were sources of infection in American-born patients. However, there is reason to believe that some of the foreign-born patients contracted the disease from infected associates after their arrival in the United States, as will be shown later in this paper.

Foreign-born patients have been admitted to the leprosarium from all sections of the country (table 1), and they have come from more than 50 different political entities (table 2). The majority of the foreign-born patients who

Figure 2. Percentages of National Leprosarium patients of foreign birth and of United States birth, 1921-53.



appeared in the Atlantic Coast States were born in European countries or the West Indies; of those who appeared in the Gulf Coast States, in the West Indies or Mexico; and of those in the

Pacific Coast States, in Mexico, the Pacific Islands, or Asia.

During the 33-year period, the number of patients of foreign birth declined more than the total number of patients fell. The yearly average number of foreign-born patients dropped from 25.0 during the period 1921-35 to 14.5 during the period 1936-53. There were 30.6 percent fewer foreign-born patients admitted during the second period than during the first. The greatest decrease, 67.7 percent, occurred among European-born patients. Patients native of Asia decreased 34.3 percent, and those native of the West Indies decreased 36.5 percent. Patients born in Puerto Rico, however, increased 100 percent, and those born in Mexico increased 22 percent.

A number of foreign-born persons in whom clinical leprosy developed after their arrival in the United States were not admitted to the leprosarium. In California, for example, 248 cases of leprosy were recognized among persons born in Mexico, but only 100 were admitted.

Table 1. Birthplace of National Leprosarium patients, according to State from which admitted, 1921-53

State from which admitted	Continental United States	Foreign countries ¹	Total	State from which admitted	Continental United States	Foreign countries ¹	Total
Alabama	4	0	4	Nevada	0	0	0
Arizona	6	3	9	New Hampshire	0	0	0
Arkansas	6	0	6	New Jersey	1	6	7
California	57	237	294	New Mexico	0	2	2
Colorado	5	8	13	New York	17	141	158
Connecticut	0	1	1	North Carolina	1	1	2
Delaware	1	0	1	North Dakota	0	0	0
District of Columbia	5	3	8	Ohio	6	5	11
Florida	88	14	102	Oklahoma	3	0	3
Georgia	8	2	10	Oregon	1	4	5
Idaho	0	0	0	Pennsylvania	3	8	11
Illinois	13	23	36	Rhode Island	0	1	1
Indiana	2	4	6	South Carolina	4	0	4
Iowa	0	0	0	South Dakota	0	2	2
Kansas	3	3	6	Tennessee	2	0	2
Kentucky	2	2	4	Texas	241	81	324
Louisiana	308	15	326	Utah	0	0	0
Maine	0	0	0	Vermont	0	0	0
Maryland	3	5	8	Virginia	3	6	9
Massachusetts	1	19	20	Washington	3	8	11
Michigan	0	13	13	West Virginia	0	1	1
Minnesota	2	7	9	Wisconsin	2	2	4
Mississippi	10	2	12	Wyoming	0	1	1
Missouri	6	4	11	Unknown ⁵	2	2	4
Montana	2	0	2	Total	822	637	1,465
Nebraska	1	1	2				

¹ Includes Territories and possessions of the United States. ² Birthplace of 3 not recorded. ³ Birthplace of 1 not recorded. ⁴ Birthplace of 2 not recorded. ⁵ State from which admitted not recorded.

The majority of the remaining 148 apparently returned to Mexico either voluntarily or through deportation procedures.

American-Born Patients

American-born patients were admitted from 33 States and the District of Columbia (table 1). Ten or more patients were admitted from only 7 States: the 4 endemic States and Illinois, Mississippi, and New York.

Not all of the American-born patients contracted the disease in this country, nor did all of them become infected in the States from which they were admitted. Many became infected while residing in endemic countries, and others, while residing in endemic States.

The number of American-born patients admitted to the leprosarium has been rather constant. The yearly average for 5-year periods from 1921-50 ranged from 22.4 to 31.0, and the yearly average for 1951-53 was 18.0.

Concentration in States

Leprosy among persons born in the United States is concentrated in Florida, Louisiana, Texas, and, to a lesser extent, California. Of the 820 American-born patients, 740 (90.2 percent) were either admitted from or born in these four States. A majority of the foreign-born patients were also admitted from these States, most of these, however, from California.

Florida

A total of 137 cases of leprosy were recognized among Florida residents during the period 1921-53. Admitted to the leprosarium were 102 of the patients.

Of the 137 patients, 111 were born in the continental United States and 96 were born in Florida. Thus, leprosy in Florida seems primarily to concern Florida-born persons.

Of the 22 patients of foreign birth, 16 were natives of the West Indies—11 of the Bahama Islands and 5 of Cuba. Of the 15 patients born in other States, 1 was a native of Louisiana, and 14 were natives of nonendemic States. (The birthplaces of 4 patients were not recorded.)

Table 2. Country of birth of foreign-born patients admitted to National Leprosarium, 1921-53

Country of birth	1921-35	1936-53	Total
Europe	93	30	123
Austria	1	0	1
Azores	1	0	1
Czechoslovakia	0	1	1
England	0	1	1
Finland	3	0	3
France	1	1	2
Germany	3	2	5
Greece	23	4	27
Hungary	2	0	2
Italy	18	8	26
Latvia	0	1	1
Lithuania	1	0	1
Norway	3	1	4
Palestine ¹	3	0	3
Poland	1	0	1
Portugal	6	0	6
Russia	10	3	13
Serbia	1	0	1
Spain	8	5	13
Sweden	1	1	2
Switzerland	0	1	1
Syria ¹	3	0	3
Turkey	4	1	5
Africa	5	2	7
Algeria	0	1	1
Cape Verde Islands	3	0	3
Malta	1	1	2
Morocco	1	0	1
Asia	35	23	58
China	28	21	49
India	4	1	5
Japan	2	0	2
Korea	1	1	2
Pacific Islands	68	41	109
Hawaiian Islands	16	10	26
Philippine Islands	49	29	78
Samoa (American)	0	2	2
Tahiti	3	0	3
North America	104	123	127
Canada	4	1	5
Mexico	100	122	222
Central and South America	19	9	28
Argentina	1	0	1
Brazil	3	1	4
British Guiana	5	1	6
Canal Zone	1	0	1
Central America ²	1	0	1
Chile	0	1	1
Colombia	1	3	4
Costa Rica	1	0	1
Dutch Guiana	4	2	6
Panama	1	1	2
Venezuela	1	0	1
West Indies	52	33	85
British West Indies	27	6	33
Cuba	7	3	10
Puerto Rico	11	22	33
Virgin Islands	5	2	7
Island not designated	2	0	2
Total	376	261	637

¹ Included with European countries because of its proximity.

² Country not indicated.

As shown by the following tabulation, there appears to be a slight downward trend in the number of patients native of the State:

	<i>Number</i>	<i>Yearly average</i>
1921-30	33	3.3
1931-40	31	3.1
1940-50	28	2.8
1951-53	4	1.3

Louisiana

Leprosy was first recorded in Louisiana in 1766-68, when cases occurring among the French were isolated at Balize at the mouth of the Mississippi River (2). In 1785, a hospital was established in New Orleans for the treatment of persons afflicted with the disease, and in 1894, the Louisiana Home for Lepers was established near the village of Carville. In 1921, this institution was acquired by the Federal Government and became the National Leprosarium.

Both the West Indies and Canada have been considered as sources of leprosy in Louisiana. According to Dyer (3), "The popular impression . . . that leprosy in Louisiana came with the Acadians from Nova Scotia . . . was due, no doubt, to the fact that among the descendants of these people leprosy has existed, but the evidence seems to point to the fact that the disease came rather through the West Indies, particularly Martinique . . . and Cuba."

From 1921 through 1953, 350 cases of leprosy were recognized in the State, and 326 of the patients were admitted to the National Leprosarium.

As in Florida, leprosy in Louisiana is primarily a problem in persons born within the State: 313 of the 350 patients were born in Louisiana. Of the 18 patients born in other States, 6 were natives of Texas, 1 was born in California, and the remainder were natives of nonendemic States. Of the 15 foreign-born patients, 1 was born in Canada, 3 in Mexico, 1 in South America, and the remainder in Europe. (The birthplaces of 4 patients were not recorded.)

The trend in Louisiana-born patients also appears to be downward, as shown by the data below. There were 45.6 percent fewer cases

recognized during the period 1941-50 than during the period 1921-30.

	<i>Number</i>	<i>Yearly average</i>
1921-30	125	12.5
1931-40	109	10.9
1941-50	68	6.8
1951-53	11	3.6

Texas

In Texas, 393 cases of leprosy were recognized during the 33-year period. Of these patients, 324 were admitted to the National Leprosarium.

Information concerning the origins of the 69 patients not admitted to the leprosarium is unavailable. Of the 324 admitted, 241 were born within the continental United States, and of these, 202 were born in Texas and 17 in the adjoining endemic State of Louisiana. Of the 81 foreign-born patients, 77 were natives of Mexico. Thus, leprosy here concerns primarily natives of Texas, Mexico, and Louisiana.

The fact that rather large numbers of Texas patients were born in Mexico or Louisiana indicates that the disease in these areas is related. Further evidence is found in these facts: Of the 202 Texas-born patients, 39 had Mexican-born parents; 32 had one parent of Mexican birth; and 5 had one parent born in Louisiana.

The majority of the 39 Texas patients born in other States probably became infected after they entered Texas. Of 20 patients born in nonendemic States, 11 had lived only in these States prior to entering Texas. They entered Texas at ages ranging from 6 to 44 years, and experienced onset of the disease in from 7 to 51 years. Seven of the 20 had lived also in other endemic areas. Of the 17 Louisiana-born patients, 11 had lived only in that State but had had no known contact with the disease. When they moved, their ages ranged from early infancy to 69 years, and the onset of the disease occurred in from 2 to 56 years. One Louisiana-born patient experienced onset of the disease before he left that State; another had had contact with an infected relative; and three had lived also in endemic countries. Of 2 California-born patients, one experienced onset of the disease before leaving that State. (Histories for 4 of the 39 patients were incomplete.)

The number of Texas-born patients admitted

to the National Leprosarium has been rather constant.

	<i>Number</i>	<i>Yearly average</i>
1921-25-----	8	1.6
1926-30-----	20	4.0
1931-35-----	44	8.8
1936-40-----	33	6.6
1941-45-----	34	6.8
1946-50-----	44	8.8
1951-53-----	19	6.3

California

Cases of leprosy recognized in California numbered 521. A few more than half of the patients, 294, were admitted to the National Leprosarium. Of the 103 admissions during the period 1921-30, 31 occurred in 1922. Prior to 1921, California had its own leprosarium, and undoubtedly many of the patients admitted in 1922 had previously been hospitalized in that institution.

Leprosy in California is primarily a disease of the foreign-born. Of the 521 patients, 436 were of foreign birth, 41 were born in other States, and only 34 were born in California. (The birthplaces of 10 patients are not known.)

Foreign-born patients. The birthplaces of the foreign-born patients reflect the immigration pattern of the State: 394 of the patients were born in the Orient, the islands of the Pacific, or Mexico. The greatest number, 248, were natives of Mexico.

Although most of the foreign-born patients probably became infected before they entered this country, it seems likely that a number of them contracted the disease after entry through contact with infected associates. This opinion is supported by the following data for Mexican-born and Philippine-born patients on elapsed time between entry into the State and onset of the disease (patients who had experienced onset of the disease prior to leaving Mexico not included):

<i>Elapsed time</i> (years)	<i>Mexicans: 91</i> (percent)	<i>Filipinos: 40</i> (percent)
Less than 10-----	30.7	82.5
Less than 15-----	57.1	87.5
More than 15-----	42.8	12.5
More than 20-----	29.6	2.5

If it should be assumed that each of these patients became infected before entering the

United States, it must be assumed also that the incubation period, for some reason, was of much longer duration among the Mexicans than among the Filipinos. There are, however, two other possible explanations for the difference:

1. Many of the Mexicans may have become infected during visits to Mexico subsequent to their initial entry into the United States. Histories of such visits have been obtained for some of the patients. The Filipinos, on the other hand, are less likely to have made frequent visits to the islands of their birth.

2. Some of the Mexican-born patients may have become infected in California, where there was ample opportunity for contact with infectious cases.

The difference in the length of time between entry and onset is not because the Filipinos were younger than the Mexicans when they migrated to the State. In fact, the Filipinos were slightly older than the Mexicans, as shown by the following tabulation:

<i>Age</i> (years)	<i>Mexicans</i> (percent)	<i>Filipinos</i> (percent)
Under 10-----	10.9	2.2
Under 15-----	23.0	11.1
Under 20-----	46.1	37.7
Over 20-----	53.8	62.2

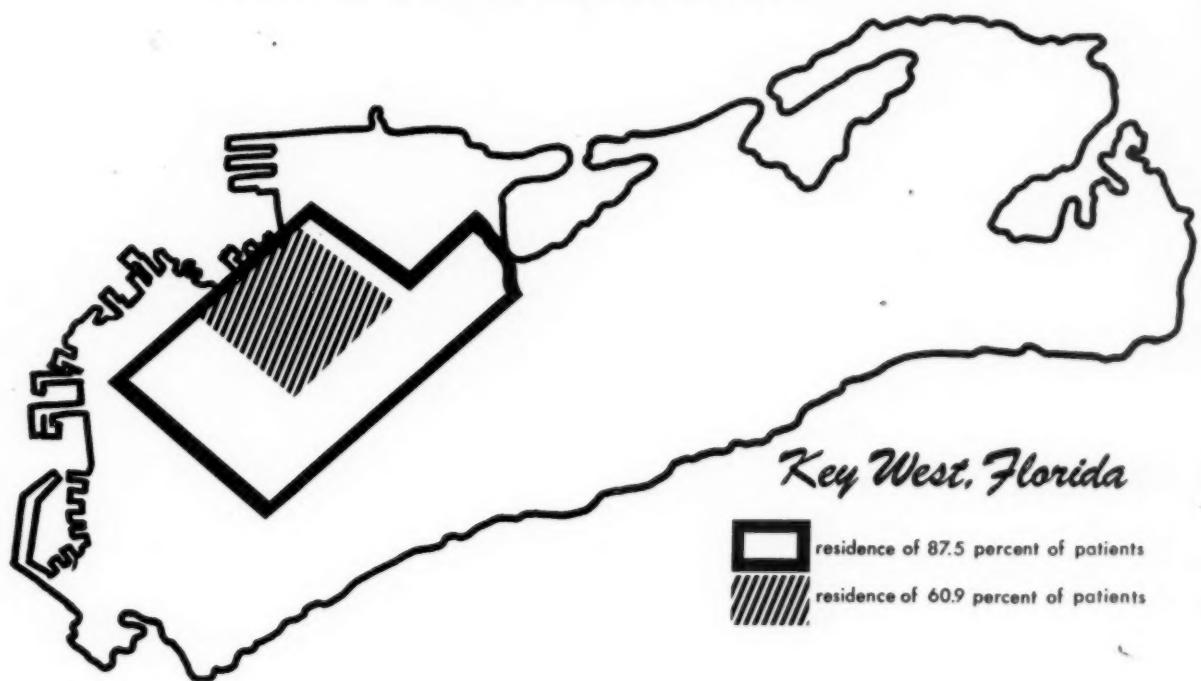
The possibility that some of the Mexican-born patients in California contracted the disease after entry is further supported by the fact that the elapsed time between entry and onset for Mexicans admitted from California was considerably longer than the elapsed time for Mexicans admitted from nonendemic States, as shown below:

<i>Elapsed time</i> (years)	<i>California: 91</i> (percent)	<i>Nonendemic States: 37</i> (percent)
Less than 10-----	30.7	64.8
Less than 15-----	57.1	81.0
More than 10-----	42.8	35.1
More than 15-----	29.6	18.9

American-born patients. The majority of the American-born patients in California probably became infected elsewhere, but a few may have contracted the disease in the State.

Of 34 patients born in California, 16 gave no history of having lived outside the State and may be assumed to have become infected in the State. Six of these 16 had had contact with cases in the family.

Figure 3. Concentration of leprosy in Key West, Fla., 1921-53.



Of the 30 patients born in nonendemic States, 10 had not lived in an endemic State or country before entering California. One of these 10 had lived in Wisconsin, Oregon, and Washington. Six had lived only in Arizona, but onset of the disease occurred in 1 before he left that State, and in 2 others 4 to 6 years after they left. One had lived only in Ohio and Illinois, and one had lived only in Minnesota. The tenth had been a merchant seaman, visiting many ports in endemic countries, and experienced onset of the disease 6 years after he settled in California.

At least 6 of the 11 patients born in endemic States other than California probably became infected before they entered the State.

Concentration in Limited Areas

Not only is leprosy confined largely to a few States in this country, it is also confined to a limited area in each of these States.

In Florida, cases were recognized among residents of only 11 of the 67 counties during the 33-year period, and among residents of only 8 counties during the last 10 years of that period.

The disease has been concentrated in one county, Monroe, and within this county, in Key

West. Of the 137 cases in the State, 44.5 percent were recognized in Monroe County. Of the 96 Florida-born patients, 44.5 percent resided in Key West at the time of diagnosis. Moreover, case histories for 94 Florida-born patients indicate that 78 of these patients probably contracted the disease in Key West.

Within Key West, the disease has been concentrated in a restricted section of the city. Of the 65 patients residing in the city while the disease was active, 56 lived within the outlined area on the map in figure 3, and 39 lived within the shaded area, an area about 5 blocks square. (The address of one patient was not determined.)

In Louisiana, the disease has been concentrated in the lower half of the State. Of the total of 350 patients, 95.1 percent resided in this section: 71.7 percent, in the 9 parishes in the southeastern part of the State; and 46 percent, in Orleans Parish. Cases have been recognized in 27 of the 35 parishes in the southern half of the State, but in only 4 of the 29 in the northern half.

The disease in Texas has been concentrated in the southeastern part of the State. Patients were admitted to the National Leprosarium

from only 53 of the 254 counties. More than 10 patients were admitted from only 7 counties; the patients from these 7 counties represented 68.2 percent of the total from the State. Only 1 patient was admitted from each of 23 other counties.

The 521 patients in California resided in 33 of the 58 counties when they were admitted to the leprosarium or when the disease was recognized. Ten or more patients resided in 11 of the counties, and 293 patients lived in San Francisco or Los Angeles County. There has not been as definite a concentration of cases in limited areas in California as in the other endemic States, but, as noted previously, many of the California patients apparently were infected outside the State.

This concentration of leprosy in limited areas is important because in many instances it is related to the possible source of infection. Particularly is this true in the consideration of the source of infection in members of the armed forces. There is a tendency to consider the source of infection of a serviceman who was born in or had lived in one of the endemic States as that State regardless of whether or not he later spent time in another endemic State or in an endemic country. Actually, if he had lived only in the northwestern part of Texas, for example, his opportunity for becoming infected was no greater than if he had lived in Colorado or Oklahoma.

Dispersion From Endemic States

Leprosy in the endemic States is also important as it relates to the disease in the non-endemic States. Forty-six patients born in the endemic States were admitted from 19 non-endemic States and the District of Columbia (fig. 4). Eight were born in Florida; 14 in Louisiana; 15 in Texas; and 9 in California.

The majority of these 46 patients probably became infected before they left their State of birth, and in some instances they have been sources of infection in persons living in non-endemic States. In 16 of the patients, the disease had become clinically manifest before they left their State of birth. Another 4 patients entered the armed services directly from the State of birth, and in each of these the onset

occurred within 2 years after they entered the service.

Eleven patients had lived only in nonendemic States after they left their State of birth and before the disease became manifest. In 4 of these the onset of the disease occurred within 4 years after they left their State of birth; in 8, within 15 years; and in 3, after more than 15 years.

From the histories of 7 of the 46 patients, it seems likely that they became infected while in foreign countries: Three had served as members of the armed forces in the Philippine Islands; two had lived in China; one in Japan; and one in Hawaii. The histories of the remaining 8 patients are insufficient for analysis.

Nonendemic States

During the period 1921-53, 415 patients were admitted to the National Leprosarium from 36 nonendemic States and the District of Columbia. Of these, 288 were born outside continental United States and 126 were natives of the United States. (The birthplace of one is not known.)

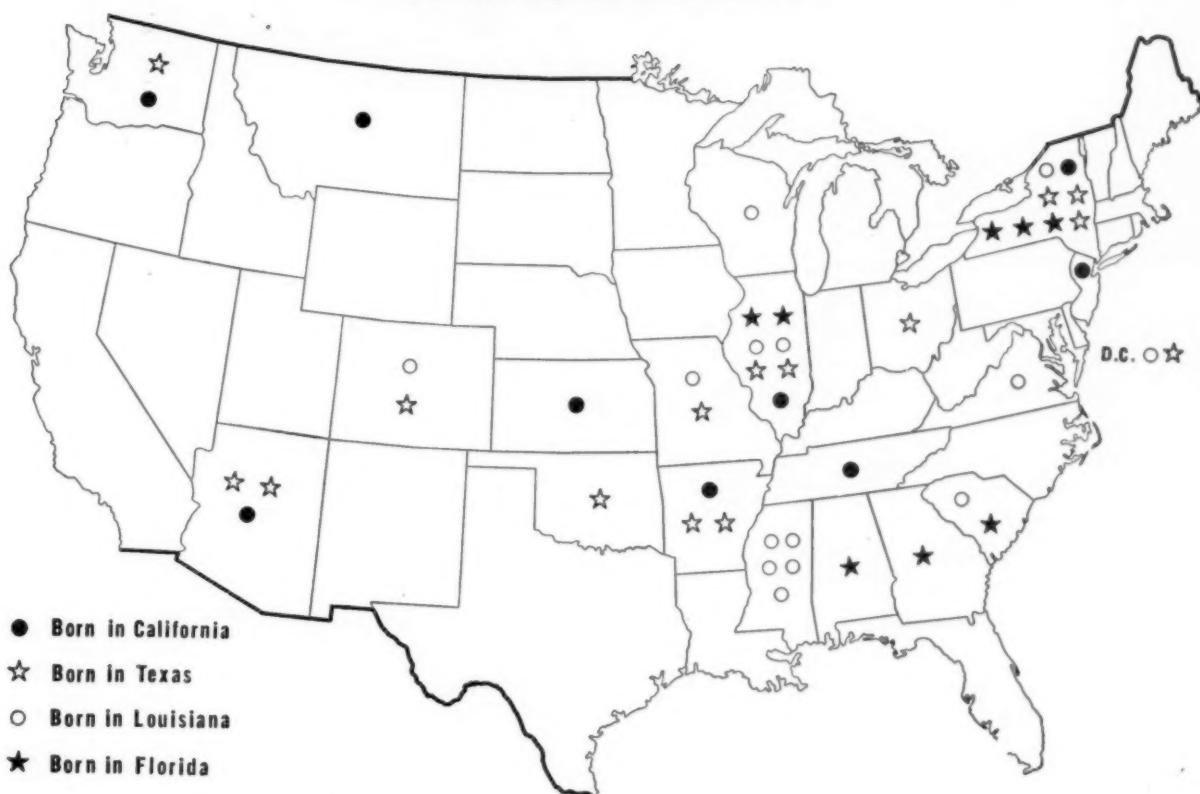
Of the foreign-born patients, 140 were admitted from New York State and 148 were admitted from 28 other nonendemic States and the District of Columbia. The greatest number of the foreign-born patients were natives of Mexico, and the next greatest number were natives of the West Indies.

The 126 American-born patients, who were admitted from 29 nonendemic States and the District of Columbia, may be categorized as follows:

Born in endemic States.....	46
Born in nonendemic States, resided in endemic areas prior to onset of disease.....	20
Born in nonendemic States, visited or traveled in endemic areas prior to onset of disease.....	6
Born in nonendemic States, served as members of armed forces in endemic areas prior to onset of disease.....	18
Born in nonendemic States, resided only in non-endemic States.....	33
Incomplete history.....	3

The majority of these patients had opportunities for becoming infected while in an endemic State or foreign country. The 46 pa-

Figure 4. Nonendemic States from which patients born in endemic States were admitted to the National Leprosarium, 1921-53.



tients born in endemic States have already been discussed. In several of the 20 who lived in endemic areas sometime after birth, the onset of the disease occurred before they left the area, and in others, shortly afterward. The 18 patients who had served in endemic areas as members of the armed forces experienced onset of the disease in from 1 to 13 years after such duty: In 9, the onset occurred within 5 years; in 15, within 10 years; and in 17, within 15 years (date of onset not given for 1 patient).

If the histories of the 33 patients who specified that they had never lived or visited in an endemic area are correct, it must be assumed that they became infected while living in nonendemic States. Nine of them gave definite histories of contact with known cases of leprosy in the nonendemic State. The possibility exists, of course, that some of the patients had visited in endemic areas but failed to give such information to the interviewers.

A majority of families in the United States in which the disease is recognized are single-

case families, and the sources of infection are apparently extrafamilial infectious cases. With such low prevalence of the disease in the nonendemic States, it is not surprising that so few cases have occurred. Undoubtedly, if there were areas in these States in which the disease was concentrated as it is in the endemic States, more cases would occur.

Of the patients who had never lived in an endemic State, the number who had lived only in northern States is about the same as the number who at some time had lived in the southern States. This strongly indicates that, providing there is ample opportunity for contact with the disease, it would occur in any part of the country, north or south.

New York State

The leprosy situation in New York is unique in that, although the disease is not endemic, a large number of patients have been admitted from the State.

The reporting of leprosy is not required in New York State, although it is in New York City. Persons with the disease are not always admitted to the National Leprosarium. Occasionally, persons residing in endemic States move to New York when they learn that they have the disease, and a few patients have absconded from the leprosarium to that State. Information on many of these persons, however, is insufficient for analysis; the following discussion therefore relates only to patients originally admitted to the leprosarium from New York.

Of the 158 patients admitted from New York, 140 were of foreign birth and only 18 were born within continental United States. Of the latter, only 2 were born in New York.

From the available information concerning the American-born patients, the majority probably became infected before entering the State. One patient, however, almost certainly became infected in the State. He had lived in New York City until the age of 42 years (1923), when he visited in Italy for 3 months. On his return the disease was recognized, and he was sent to the leprosarium from the Immigration Station. The onset of the disease had occurred in 1921. Another patient may have become infected in New York. Born in Tampa, this patient moved to New York at the age of 6 years. There he lived with his aunt, who had moved to New York from Florida a year after she developed clinical manifestations of leprosy. The aunt was admitted to the leprosarium 6 years after moving to New York, and 9 years later onset of the disease occurred in the nephew.

Of the foreign-born patients, the greatest number, 59, were natives of the islands of the West Indies, and the next greatest number, 34, were natives of the countries of Europe. As in California, it seems likely that some of the foreign-born patients in New York contracted the disease after entry into this country. With 158 patients admitted to the leprosarium and many more not admitted, there has been ample opportunity for contact with infectious cases within the State. Nearly one-half (47.4) of the patients admitted were admitted more than 5 years after the onset of the disease; 17.5 percent, more than 10 years after onset. As shown

in the following tabulation, the length of time between entry into this country and onset of the disease was considerably longer for European-born patients than for patients born in the West Indies:

<i>Elapsed time</i>	<i>Europeans: 24</i>	<i>West Indians: 35</i>
<i>(years)</i>	<i>(percent)</i>	<i>(percent)</i>
Less than 10	33.3	82.8
Less than 15	66.6	94.2
More than 15	33.3	5.7
More than 20	25.0	2.8
More than 30	8.3	0

Based only on the number of admissions to the leprosarium, the trend of the disease in New York is downward. There were 51 percent fewer patients admitted during the period 1936-53 than during the period 1921-35. Patients of European birth decreased 82.7 percent, and those of West Indian birth, 15.6 percent. Although the number of patients from Puerto Rico is small, patients native of this island increased 70 percent. Whether the apparent downward trend is actual or due to a decrease in the admission of recognized patients is not known.

Summary

Leprosy in the United States is a definite, though not a great, public health problem. The disease may occur in, and be transmitted in, any section of the country. Although a large proportion of the recognized cases have occurred in persons of foreign birth, a majority have occurred in natives of the United States. It must not be assumed, however, that all the patients of foreign birth became infected before entry into the United States, although a majority probably did. In the majority of American-born patients, the disease was contracted in this country.

A majority of the cases have occurred among residents of New York, Florida, Louisiana, Texas, and California, and most of the American-born patients have been natives of Florida, Louisiana, or Texas. The disease has been concentrated in restricted areas of Florida, Louisiana, Texas, and California. A number of patients recognized in the nonendemic States became infected in the endemic States.

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International Conference on Arid Lands

The need for a unified research approach to problems of water supply and food production in areas where water is scarce was stressed at the International Symposium and Conference on the Future of Our Arid Lands.

The meetings, held at Albuquerque and Socorro, N. Mex., from April 26 to May 4, 1955, were sponsored by the American Association for the Advancement of Science and its Southwestern and Rocky Mountain Division and were supported by the National Science Foundation, the Rockefeller Foundation, and the United Nations Educational, Scientific, and Cultural Organization.

Col. Omar Draz of the Egyptian Army Veterinary Corps, director, desert range development project, Desert Institute, Heliopolis, Egypt, in his address on the adaptation of plants and animals to arid conditions said, "The growing world population, together with the need to raise the standard of living for millions of people who suffer hunger or malnutrition, makes the increase of the world food production an urgent and vital requirement."

The symposium consisted of four technical sessions on: variability and predictability of water supply in arid regions; improved use of present resources; prospects for additional water sources, including questions on the practicability of weather control, demineralizing saline water, and re-using waste waters; and adaptation of plants and animals to arid conditions.

The American Association for the Advancement of Science will publish the symposium papers and specific recommendations of the conference. Further information may be obtained from John A. Behnke, Associate Administrative Secretary, American Association for the Advancement of Science, 1025 Connecticut Avenue, N. W., Washington 6, D. C.

1954 Summary of Disease Outbreaks

By C. C. DAUER, M.D., and GRANVILLE SYLVESTER

WHEN pestilence falls on the people there is a story to tell," Geddes Smith wrote in 1941 (1).

Our story of the epidemics and other unusual occurrences of disease that "fell on the people" of the United States in 1954 concerns groups of people—children in school and in camps, families, picnickers, hospital and other institution inmates, restaurant and hotel patrons, and others.

More than 10 percent of all reported outbreaks of staphylococcal food poisoning and foodborne or waterborne outbreaks of shigellosis, salmonellosis, typhoid fever, and undifferentiated gastroenteritis occurred in public and private schools (table 1). Three-fourths of the 12 reported foodborne or waterborne epidemics of *Shigella* infections were in schools. In addition to these 9 outbreaks there was another epidemic of 234 cases in which the infection was considered to be transmitted by person-to-person contact. One epidemic of typhoid fever occurred in a private school. The 26 outbreaks of various types in schools were reported from 12 different States and about half of them from 3 States. It is quite probable that many other unreported outbreaks occurred in the remaining 36 States. These outbreaks, even

though they occurred in a limited number of areas, point to a need for improving the environment of children in public and private schools.

All reported foodborne and waterborne outbreaks of shigellosis, with one exception, occurred in schools, hospitals, and institutions. In the latter group, predominantly institutions housing mentally deficient and mentally diseased persons, there also were four outbreaks of shigellosis which were considered to have been transmitted by person-to-person contact. All of them occurred in the institutions of one State, but similar unreported outbreaks undoubtedly occurred in other States. Because of the inherent difficulties in maintaining reasonably high standards of personal hygiene in these populations, such outbreaks are not unusual.

The outbreaks listed as occurring in households or families were relatively numerous, but most of them consisted of a few cases. The large proportion of typhoid fever occurrences is not surprising since carriers commonly prepare food for consumption in their homes. The list of household outbreaks would be even more impressive if trichinosis and botulism were added since these diseases occur predominantly in families.

The outbreaks and persons affected among patrons of restaurants, hotels, and private clubs or dining halls were numerous, as would be expected since large numbers of persons eat in these establishments. A large proportion of outbreaks followed a reception or a banquet in such places.

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A large number of persons were affected in outbreaks following attendance at picnics and similar social gatherings, but this may possibly be a reflection of the numbers who attended, as well as increased opportunities for consumption of food exposed at temperatures favorable for bacterial growth. Outbreaks following church socials included the familiar story of a typhoid fever epidemic following a church supper.

The number of outbreaks in summer camps was not large since all of them were reported by two States. None of the more serious types of foodborne or waterborne diseases, such as shigellosis, salmonellosis, and typhoid fever, were reported in this group in 1954. Outbreaks in labor camps were also few in number, possibly because such groups are not as numerous as some of the others listed.

The small number of outbreaks among passengers on trains, airplanes, or ships may be due in part to under-reporting since many patrons of dining services on trains and airplanes would have reached their destinations and would have scattered before onset of symptoms. On the other hand, the small number of outbreaks may also be a reflection of the attention given to dining car sanitation on trains and supervision of

food services on other interstate carriers (2). No outbreak was reported among patrons of railway dining cars, although one did occur among members of a dining car crew.

The outbreaks listed under the category of communities consist of those in which there was distribution of infected foods from bakeries and other retail stores to various persons in a community. They also include those in which polluted water caused illness in a community.

Waterborne Disease Outbreaks

In 1954, only four outbreaks were reported in which there was good evidence that water was the vehicle of infection. There were also three other outbreaks in which water was suspected as the source of infection.

One of the four waterborne outbreaks was typhoid fever in a coal mining village where water was pumped from a worked-out section of a mine into the distributing system of the town. Two outbreaks of gastroenteritis were reported. One was explosive and followed contamination of the water supply after heavy rains; the other occurred in a recreational area where untreated well water was used.

Table 1. Certain foodborne and waterborne disease outbreaks,¹ by type of population, 1954

Type of population	Staphylococcal food poisoning			Shigellosis			Salmonellosis ²			Typhoid fever ²			Other types gastroenteritis		
	Number reporting	States	Number outbreaks	Number reporting	States	Number outbreaks	Number reporting	States	Number outbreaks	Number reporting	States	Number outbreaks	Number reporting	States	Number outbreaks
Public and private schools	5	5	309	7	9	945	2	2	157	1	1	21	5	9	824
Colleges	1	1	469				1	1	16				4	5	252
Households	6	21	93				4	8	91	6	12	38	6	19	129
Church socials	2	4	102				2	2	440	1	1	12	2	2	98
Restaurants and hotels	9	19	278				4	5	107				4	14	312
Private clubs and dining halls	8	12	1,020				2	3	106				6	6	285
Picnics	5	11	1,564										3	4	1,235
Summer camps	1	2	111										1	7	311
Labor camps	1	2	92	1	1	15							3	6	376
Hospitals	4	4	208	1	1	57	2	3	68				3	4	226
Institutions	2	3	92	1	1	15	1	1	32	1	1	7	2	2	110
Common carriers		4	203										1	1	10
Communities	6	10	165				2	2	116	1	1	9	2	6	428

¹ Outbreaks on military establishments excluded.

² Includes single-case family occurrences.

Other outbreaks suspected of being waterborne included three of gastroenteritis following consumption of water of doubtful sanitary quality. Single cases of typhoid fever were also reported in which it was found that infection followed the use of water from wells. However, these are not included in table 2. Thirteen cases of gastroenteritis were reported among members of a basketball team who drank water from a school well which, on examination, was found to be polluted.

Milkborne Disease Outbreaks

The number of outbreaks in which there was definite evidence that milk or a milk product was the vehicle of infection was not large. In one instance, four persons in a family developed brucellosis after drinking raw milk from a cow that had aborted. The source of infection of six cases of typhoid fever in two families was traced to raw milk from a dairy farm where a carrier was found handling the milk. An outbreak of salmonellosis followed the consumption of eggnog in an institution. The person who prepared the eggnog was found to be a carrier of *Salmonella typhimurium*, the same organism that was recovered from the patients. Another outbreak in a hospital in which *S. typhimurium* was isolated followed the consumption of a food in which cheese was an ingredient. A group of five persons became ill with staphylococcal food poisoning following the consumption of ice cream. The chef who prepared the ice cream harbored *Staphylococcus aureus* in his throat, and he also had chronic paronychia on all fingers of both hands.

Nine persons in a family outbreak developed gastroenteritis after eating a food containing a cream cheese from which a gram-positive coccus was isolated. A staphylococcal food poison outbreak of about 100 cases was traced to ice cream. The ice cream mix had been allowed to stand at room temperature for several hours prior to freezing. Several cases of tuberculosis in children followed the consumption of milk from herds of cattle, in one of which 80 percent were found to be tuberculin reactors.

Four outbreaks were reported in which milk

Table 2. Foodborne and waterborne disease outbreaks reported in 1954 by vehicle of infection

Area	Water		Milk and milk products		Other foods	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
United States	7	452	9	200	234	11,704
New England:						
Maine					2	11
New Hampshire					2	111
Vermont						
Massachusetts					5	202
Rhode Island					1	159
Connecticut					2	150
Middle Atlantic:						
New York	2	50	1	42	33	1,634
New Jersey						
Pennsylvania					3	22
East North Central:						
Ohio					3	176
Indiana					11	909
Illinois					17	1,442
Michigan					1	8
Wisconsin						2
West North Central:						
Minnesota						2
Iowa						1
Missouri						50
Kansas						3
South Atlantic:						
Maryland						5
District of Columbia						210
Virginia						1
West Virginia	1	9	1	6	4	622
North Carolina					1	3
Florida					8	525
East South Central:						
Kentucky	1	13			2	93
Tennessee	1	180			7	1,689
West South Central:						
Arkansas						2
Louisiana						70
Texas						1
Mountain:						74
Montana						1
Colorado						15
New Mexico						2
Utah						35
Nevada						1
Pacific:						27
Washington						1
Oregon						3
California	2	200	3	20	86	1,609
Alaska						1
Hawaii						26
Puerto Rico					3	257
					1	100

Table 3. Foodborne, waterborne, and other disease outbreaks by type of infection, reported in 1954

Area	Typhoid fever		Salmonellosis		Shigellosis		Trichinosis		Botulism		Staphylococcal food poisoning		Gastroenteritis		Toxic agents and toxic foods	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
United States	16	92	26	1,164	19	1,471	6	53	8	18	100	4,868	103	5,914	10	279
New England:																
Maine																
New Hampshire																
Vermont																
Massachusetts			1	16		1	60						3	86	2	159
Rhode Island													1	159		
Connecticut			1	50									1	100		
Middle Atlantic:																
New York		3	123		6	201							12	531	26	1,399
New Jersey													1	5		
Pennsylvania													2	17		
East North Central:																
Ohio	1	7	1	20	1	150	1	6								
Indiana	1	4	1	26	2	198							1	2	3	8
Illinois	1	5	3	233	2	264							9	451	4	494
Michigan																
Wisconsin																
West North Central:																
Minnesota			2	40	1	15									1	68
Iowa													1	50		
Missouri	1	5														
Kansas			1	350									1	57	1	51
South Atlantic:																
Maryland													1	135	3	73
District of Columbia	1	2											1	32		
Virginia													2	569	2	53
West Virginia	2	15											1	3		
North Carolina	1	8											3	425	6	300
Florida													3	230	2	56
East South Central:																
Kentucky													2	93	1	13
Tennessee	1	21			2	287							3	556	2	1,005
West South Central:																
Arkansas													1	39	1	31
Louisiana													1	74		1
Texas													1	500		160
Mountain:																
Montana			1	15												
Colorado													1	2		
New Mexico													1	35		
Utah													1	3		
Nevada													1	27		
Pacific:																
Washington	4	8	1	21	1	15	1	7	1	2	3	80	2	39		
Oregon			1	20	1	7			1	1	4	13			1	8
California	3	17	9	150	2	274			2	6	36	452	41	1,220	4	27
Alaska													1	26		
Hawaii			1	100									1	100		1
Puerto Rico													1	100		57

NOTE: Includes outbreaks reported on military installations. Includes outbreaks not shown in table 1.

or milk products were suspected as vehicles of infection. Four cases of typhoid fever occurred in a family which used raw milk, but definite proof that milk was the vehicle of infection was not obtained. In a school, 61 cases of shigellosis occurred under conditions which suggested that milk was contaminated by a student assistant in the cafeteria. A sour cream sauce was considered to be the vehicle of infection in 20 patrons of a restaurant who developed gastroenteritis, but no laboratory specimens were available for examination. Cheese used in preparation of a food, and from which a gram-positive coccus was isolated, was regarded as the source of infection in a family outbreak of gastroenteritis.

Other Foodborne Outbreaks

As in the past few years, food other than milk and milk products accounted for the vast majority of the outbreaks reported. As shown in table 2, there were 234 outbreaks reported in 32 States, the District of Columbia, and two Territories. In these outbreaks, 11,704 cases were reported, compared with 9,914 cases in 194 outbreaks for 1953. The foods most frequently incriminated were turkey, custard-filled pastries, and ham, followed by chicken and potato salad. Foodborne outbreaks of *Salmonella* and *Shigella* types of infection, in many instances, were traced to a carrier who prepared or assisted in preparation of food. As in previous years, evidence of improper handling of food or lack of adequate refrigeration was frequently found on investigation of foodborne disease outbreaks.

Typhoid Fever

During 1954, 9 States and the District of Columbia reported 16 outbreaks of typhoid fever with a total of 92 cases (table 3), as compared with 12 outbreaks with 75 cases in 1953. These figures do not include single-case family outbreaks. In 5 of the 16 outbreaks in 1954, carriers were found in close association with the cases. Milk was considered to be the vehicle of infection in one instance, and water was suspected in another. A cook was found to be a carrier, upon investigation of an out-

break of 21 cases in a school, and in another instance a carrier helped prepare food for a wedding reception. Twelve guests developed typhoid fever following the reception. The probable source of infection of an outbreak in a mining town was water from a worked-out section of a coal mine which was used to supplement the usual water supply from a drilled well. All of the cases occurred in the area receiving the untreated mine drainage. Raw milk, handled by a carrier, was suspected as the vehicle in another outbreak.

The person who developed the initial case in a small outbreak had been swimming daily in a stagnant pool of water and had eaten crayfish from the pool. Two additional cases developed in family associates of the first case. Five cases of typhoid fever developed in two families, after one of them had returned from a visit in Mexico. Spread appeared to be by contact among the members of the two families.

Salmonellosis

Reports of 26 outbreaks of salmonellosis were received from 12 States and 1 Territory in 1954. While the number of outbreaks is only 5 more than the 21 reported for 1953, the number of cases (1,164) associated with them were more than double the 533 given for 1953. Of the total cases reported in 1954, 1,090 cases in 22 outbreaks were associated with food. Three large outbreaks, in which 100 or more cases developed, were reported during the year. In one State, 350 cases occurred among a group of church members who had eaten a turkey dinner. Eleven of 25 food handlers were found to harbor a *Salmonella* organism following the outbreak. In another outbreak, 100 cases occurred in a community after residents had eaten pork which had been roasted and packaged in what appeared to be unsanitary conditions. The other large outbreak occurred among pupils in four schools participating in hot-lunch programs. The schools were served from a central kitchen, and it is believed that the food was contaminated by a carrier, although none was found. Two outbreaks resulted from milk products, and in one outbreak contact with chicks was regarded as the probable source of infection. Chicks given

away at Easter were found to harbor *S. typhimurium*.

In one outbreak, the vehicle of infection was watermelon which was found to contain a *Salmonella* organism (3). It was demonstrated that the melons had been contaminated in the process of cutting in a market. The source for many outbreaks was not definitely established, but in 11 outbreaks a carrier was found or suspected.

Ten types of *Salmonella* organisms were isolated from stool specimens of cases and/or carriers, or from food. *S. typhimurium* was the most frequently isolated. Other types reported were *S. newport*, *S. bredenii*, *S. oranienburg*, *S. montevideo*, *S. munchen*, *S. enteriditis*, *S. tennessee*, *S. panama*, and *S. sendai-miami*.

Shigellosis

Outbreaks of shigellosis were reported by 10 States (table 3). All but 2 of 19 outbreaks were in schools (9), institutions (6), and hospitals (2). The exceptions were outbreaks in a slum housing area and a transient labor camp. The mode of spread of the latter 2 outbreaks were similar, in that washing facilities were common to several families. The spread was probably by person-to-person contact which was favored by a lack of personal cleanliness. A large outbreak involving 234 cases in a school also was associated with fecal contamination. The initial cases probably resulted from children playing in water contaminated with sewage following heavy rains which had caused an overflow from sewers in a poor section of the community.

Carriers were discovered in six outbreaks in which food was the vehicle of infection. In two other outbreaks of shigellosis, the vehicle of infection was not determined, but the presence of carriers was suspected. In an outbreak of 61 cases which occurred in a school, the investigation revealed that a student assistant, subsequently found to be carrying *Shigella* organisms, was using a bad technique in handling milk and could easily have contaminated it. However, other unsanitary conditions were also found in the school.

Most of the outbreaks (11) were from Sonne-

types of organisms. Seven were *flexneri* types, and one was a *paradysenteriae*.

Staphylococcal Food Poisoning

The number of reported outbreaks of staphylococcal food poisoning has been increasing continuously during the past few years, and it is likely that this is due, in part, to better reporting.

Staphylococcus aureus was isolated in 23, and *Staphylococcus albus* in 3 of the 97 outbreaks listed in this category. The type of etiological agent was not established in many of the remaining outbreaks because there was no food available for laboratory examination. Only a few of the food handlers yielded staphylococci on examination of throat swabs or material from lesions on exposed surfaces.

Lack of refrigeration and improper food handling practices were considered frequently to be contributing factors.

Botulism

Eight outbreaks of botulism were reported in 1954. In three of these, the organism was identified as type A. Five of the outbreaks resulted from home canned foods—peaches, okra, beets, and asparagus. The vehicle of infection was not found for one outbreak, and a glass-packed pork product manufactured by a local company was responsible for another. All unused lots of the pork were recalled, and no additional cases have occurred. *Botulinus* toxin was demonstrated among the recalled lots. Investigation revealed unsanitary conditions and a faulty process at the plant.

Other Types of Poisoning

Several types of poisoning were reported during 1954. Poisoning following the eating of fish was reported in three groups of persons. Each outbreak was described as scambroid fish poisoning, a type of intoxication which is due to the production of a histaminelike substance resulting from bacteriological action on the flesh of fish.

Poisoning was reported in five persons who ate mussels taken from the ocean during the

season when these shellfish are known to contain toxic substances.

Two cases of poisoning were reported following consumption of tree tobacco (*Nicotiana glauca*).

Three outbreaks of chemical poisoning were reported. One outbreak of 160 cases followed the drinking of an acid fruit juice which had been stored overnight in a galvanized container. Another outbreak followed consumption of a soft drink which, on laboratory examination, revealed the presence of arsenic. Parathion poisoning in 10 laborers living in a migrant labor camp was suspected. One patient had signs of central nervous system involvement, but normal cholinesterase blood levels were found in all patients.

Trichinosis

Six outbreaks of trichinosis were reported in 1954 as compared with the 13 for 1953. The total (53) cases for 1954 was also similar to that (40) reported in 1952. In 1953, one large outbreak associated with infected hogs accounted for 73 cases, while the largest outbreak in 1954 involved 17 persons who ate sausage from two infected hogs which had been butchered by a friend. Three other outbreaks in 1954 were associated with pork products, and one was from the ingestion of bear meat. In one instance, grain fed hogs were implicated. The source of the infection was probably rats observed on the farm where the meat was obtained. In one State, some meat markets were found to be grinding beef without adequately cleaning grinders after grinding pork products. This practice may have resulted in at least one case. In each of the five outbreaks reported in 1954, examination of meat specimens revealed the presence of *Trichinella*.

Gastroenteritis

In 63 of the 103 outbreaks of gastroenteritis reported in 1954, there was not sufficient information from epidemiological reports to classify the etiological agent. For more than half of these, no food was available for laboratory tests, and for a large number no pathogens were isolated from the suspected food. For a few, no

bacteriological examinations were performed. Five of these outbreaks were probably of viral origin and may have been spread by person-to-person contact. An additional 13 outbreaks involving 489 cases were associated with various organisms. In three outbreaks, streptococci were isolated, and in a few, gram-positive cocci were isolated. In other outbreaks enterococci, *Escherichia coli*, paracolon and proteus organisms were isolated.

Of the total of 103 outbreaks, 68 resulted from food, 5 from water, and 3 from milk; for 27, the source was not found. Three outbreaks were associated with milk products. One waterborne outbreak was caused by drinking water that had been contaminated with flood waters.

A large proportion of the gastroenteritis outbreaks resulted from improper handling of food in restaurants and cafeterias. Some occurred in picnic and labor groups following the consumption of food left unrefrigerated for hours in the open. Many outbreaks were in private homes and schools.

In 1953, a number of outbreaks were associated with Government surplus stock turkeys. Although turkeys were responsible for a large number of outbreaks in 1954, none implicated Government surplus stock.

A large outbreak involving approximately 50,000 cases is not shown in table 3. This outbreak occurred in the general population of a metropolitan area. Extensive laboratory examinations were made, but the etiological agent was not determined.

Miscellaneous Outbreaks

Information was received regarding 10 outbreaks of diarrhea of the newborn which affected 140 infants and resulted in 27 deaths. In one instance, cases followed the return of a nurse who had been off duty 2 days with diarrhea. Two outbreaks occurred concurrently with numerous cases of diarrhea in the communities in which the hospitals were located. Overcrowding in the nursery for the newborn was considered as a contributing factor in one outbreak. Of the 27 deaths, 12 were reported to be in premature infants. In two outbreaks, *E. coli* were found in stool specimens.

Only two instances of laboratory infections were reported. In one, seven cases of endemic typhus fever probably resulted from inadequately sterilized equipment. A case of diphtheria developed in a laboratory technician who accidentally spilled a suspension of infectious material on her hands.

Information on 5 outbreaks of diphtheria was received from 4 States. Sixty-nine cases were reported, of which 25 occurred in and around a small town of 375 inhabitants. This was an unusually high incidence for an area of that size. In one State, the disease appeared among persons in older age groups, especially those housed in cheap transient hotels.

Streptococcal infections were reported by only two States. In one, there were 5 cases in a camp; in the other, 3 schools were involved and approximately 400 pupils developed the disease. In all instances, the disease was spread by personal contact.

An outbreak of arthropod-borne encephalitis was reported in the Rio Grande Valley of Texas during August and September 1954. It is estimated that about 600 cases occurred. The St. Louis type of virus was isolated from two fatal cases, and serologic tests also indicated this type of infection. In California, 96 laboratory confirmed cases of St. Louis encephalitis and 22 cases of western equine type of infection were reported in July through September. In 1952, 375 laboratory confirmed cases of western equine encephalitis and 45 cases of St. Louis type of infection were reported. In addition to these outbreaks, an unusually large number of meningoencephalitis cases were reported in Oregon.

Marsh gas poisoned 11 persons of a crew who were constructing a sewer line through marshy land. Poor ventilation in the trench permitted a sufficiently high concentration of gas to cause symptoms in some workers.

Epidemiological information was received on 34 outbreaks of infectious hepatitis. The infection in most of these outbreaks was considered to have been spread by person-to-person contact. No common source—such as food, milk, or water—was found in any of these outbreaks. Twenty-five of the total outbreaks occurred in schools and institutions, particularly institutions housing mentally ill patients.

Three outbreaks were among persons of low-income status. While the number of cases reported in epidemics was 1,315 in 1954, compared with 1,578 for 1953, the total numbers of cases reported weekly for 1953 and 1954 were 33,382 and 49,739, respectively. This indicates that many outbreaks probably were not investigated or reported.

The only outbreak of locally acquired infection reported was a group of four cases of malaria in one family. A high incidence of Coxsackie virus infections was reported in various parts of a State, and group B virus was isolated from many of the cases. Several hundred cases of an infection characterized by a purplish maculoannular rash was reported in one area, the etiology of which was not determined. Numerous reports on the epidemiological investigation of tularemia cases were received, all of which followed exposure to rabbits. Other reports included information on cases of ringworm, psittacosis, scrub typhus, mycotic infections, leprosy, Rocky Mountain spotted fever, brucellosis, anthrax, and leptospirosis.

Epidemiological information on 9 cases of human rabies occurring in 1954 were received, 3 from 1 State, and 1 each in 6 different States.

Only 2 instances of plague infection were reported in continental United States, and 2 in Hawaii. Each of these represent an isolation from rat fleas.

Information on 8 suspect cases of smallpox in 6 States was received. However, acceptable criteria for confirmation of diagnosis were lacking in each of them.

Although some outbreaks of poliomyelitis were reported, they are not included in this report.

There were no widespread outbreaks of influenza in the United States in the winter of 1953-54. Its sporadic occurrence has been reported by Davis (4).

Summary

This report summarizes the outbreaks and epidemiological information on unusual occurrences of diseases in the United States in 1954. Since outbreaks from common sources—food and water—appear to be brought more com-

monly to the attention of public health officers and to be investigated, reports on these outbreaks constitute a large part of the material presented here.

The relative frequency of the various types of disease outbreaks, by States, and the frequency of foodborne and waterborne disease in different groups of persons are discussed.

There is reason to believe that the reports received represent only a fraction of the outbreaks that actually occurred. Reports appear to be relatively complete in some States and poor or nonexistent in others.

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Bicarbonates, sulfates, and chlorides of calcium and magnesium in water are appraised as a source of interference with the germicidal action of quaternary ammonium compounds at various temperatures.

Bactericidal Efficiency of Q.A.C. in Different Waters

By CECIL W. CHAMBERS, A.B., PAUL W. KABLER, M.D., Ph.D., ALTON R. BRYANT, B.S.,
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INTERFERENCE of natural tap water with the bactericidal action of quaternary ammonium compounds (Q.A.C.) was first reported by Hanne, referred to by Lawrence (1), and has since been confirmed by other investigators: Public Health Service (2), Ridenour and Armbruster (3), Shere (4), Butterfield, Wattie, and Chambers (5), Humphreys and Johns (6), and others. This study was initiated to further determine and evaluate some of the causes of inhibition of Q.A.C. bactericidal action.

Experimental Methods

One ml. of *Escherichia coli* ATCC-11229 suspension was added to 99 ml. of water-germicide mixture to produce an initial bacterial density of approximately 100,000,000 organisms per ml. Test temperatures were thermostatically controlled at the various levels reported. At spe-

cific intervals, aliquots were transferred to Tween 80 Asolectin neutralizer, Weber and Black (7), from which duplicate portions were planted for agar plate colony counts. An experiment usually was made with 2 or 3 replicate test flasks for each germicide.

The method used was similar to the Weber-Black procedure (7) but differed from it as follows: (a) larger volumes were used to provide material needed for chemical control tests; (b) more than one test temperature was used; (c) bacterial suspension was prepared in phosphate buffered water instead of in test water; (d) suspension was filtered through sterile paper, eliminating most of the "freak jumps"; (e) suspension was stored in ice throughout a given experiment (this did not affect the test temperature as the ratio of suspension to test water was 1 ml. to 99 ml.); (f) culture was added to test mixture instead of test mixture to culture; (g) duplicate plates, using phosphate buffered dilution water, were planted in the range expected to yield 30 to 300 colonies; (h) initial and final numbers determinations were based on triplicate plates.

Controls and Compounds

Sterility control was maintained on all water, neutralizer, media, dilution blanks, and equipment used. It was inadvisable, due to the

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breakdown of bicarbonates, to sterilize raw and tap waters. Controls indicated the presence of extraneous bacteria in some of these waters. Such contaminants, when present, were insufficient in number to affect the initial numbers determination at a dilution of 10^{-6} . These organisms did not result in germicide consumption, and they were killed during the waiting period allowed for the test mixture to come to constant temperature. However, when such contaminants were present on control plates, representative colonies were transferred to lactose broth to prove the absence of coliform organisms. Likewise, representative colonies surviving the longest exposure in germicide tests were transferred to lactose to exclude the possibility of counting extraneous noncoliform contaminants as *E. coli*.

The quaternary ammonium compounds used were: compound A—alkyl dimethyl benzyl ammonium chloride; compound B—para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride, and compound C—alkyl tolyl methyl trimethyl ammonium chloride.

Water Selection, Preparation, Measurement

Norwood, Ohio, well water was used in a considerable portion of this work because: (a) it was readily available; (b) previous studies (2, 5) had shown that this water interfered with Q.A.C.; (c) waters with an equal or higher mineral content are common on many dairy farms; (d) numerous municipalities, especially in the west and southwest, use waters with equally high or higher mineral content. The State health departments of Arkansas, Kansas, and Texas provided laboratory facilities, engineering services, and sample collectors, which enabled personnel associated with this project to conduct laboratory investigations in these areas.

Forty-five different types of well, tap, synthetic (distilled water with minerals added), softened, and sequestered waters were investigated. Tap and well waters were used fresh and unaltered, except when chlorine was present a slight excess of sodium sulfite was used for dechlorination. These waters were also investigated after being treated as follows: (a) boiled 2 hours, evaporation loss being restored with distilled water; (b) boiled, cooled,

and recarbonated with CO_2 , then decarbonated by shaking to adjust pH to the same level as that of the raw water before boiling; (c) stored at room temperature for 3 to 10 days; (d) lime softened; (e) partially softened by zeolite; (f) sequestered with either sodium hexametaphosphate (S.H.M.P.), tetrasodium pyrophosphate (T.S.P.P.), or the tetrasodium salt of ethylenediamine tetra acetic acid (E.D.T.A.).

In all experiments, any precipitate in the water was suspended by agitation while aliquots were being transferred to test flasks. Lime-softened water, in which removal of the sediment is an integral part of the process, was an exception to the preceding statement.

Results

Space limitations prevent the presentation of all data available. Results reported are considered representative of the more significant trends. With the exception of two tables, data obtained with long exposure intervals have been deleted. Findings are reported as percentages of bacteria surviving for a given exposure, based on the initial numbers determination as 100 percent.

A succession of individual experiments, constituting a series, were run with fresh, synthetic, or treated water. In a series using fresh and treated water, aliquots of treated water as well as those used unaltered were drawn from a common sample of fresh water. Most results reported are averages obtained in two or more series of individual experiments. Each series started with a new sample of water of a given type or, in the case of synthetic water, a freshly prepared batch. There was relatively little experimentation with trace elements and exclusion tests.

Calcium and Magnesium

According to Foulk (8), calcium and magnesium usually occur as bicarbonates in waters found in strata of the type bearing Norwood water. Therefore, the effect of these bicarbonates was investigated in natural waters and as the pure compounds produced in distilled water.

In tests with compound A in raw Norwood water, with a total hardness of 410 p.p.m. and

a combined calcium and magnesium bicarbonate content of about 350-375 p.p.m., marked interference with bactericidal action occurred (table 1). In this and all future references, bicarbonate alkalinites (regardless of attached ion), calcium salts, magnesium salts, and hardness are given as p.p.m. CaCO_3 according to reporting conventions of Standard Methods for the Examination of Water and Sewage (9). Additional results with raw Norwood water are presented in tables 4 and 5.

When an aliquot of Norwood water was boiled, precipitating the bulk of the bicarbonates as normal carbonates, the bicarbonate and hardness content dropped to 70 p.p.m. and 90 p.p.m., respectively, and interference was re-

duced from 8- to 25-fold at exposure intervals of 1 and 2 minutes (table 1). Recarbonation of an aliquot of this same water restored the interference. A comparison of results presented in tables 1 and 2 shows that pure calcium and magnesium bicarbonate in distilled water, in amounts equivalent to the total bicarbonate content of Norwood water, interfere to a degree comparable to raw Norwood water. In all instances rapid kills were obtained in distilled water with no hardness added.

The effect of several calcium and magnesium salts in distilled water, at concentrations equivalent to the total calcium and magnesium content of Norwood water, was investigated. These results indicated that, within the limits of the

Table 1. Effect of different waters on the bactericidal efficiency of Q.A.C.

Water source and Q.A.C.	pH	Average percentage of <i>Escherichia coli</i> surviving at 22° C. after (minutes)						
		Fresh tap water						
		1/4	1	2	5	10	20	30
<i>Compound A,¹ 50 p.p.m.</i>								
Topeka, Kans.	9.8	104	16	4.8	0.015	<0.0001	-----	-----
Dermott, Ark.	9.5	0.0003	0	0	-----	-----	-----	-----
Port Isabel, Tex.	7.5	-----	-----	110	104	56	6.4	-----
Norwood, Ohio	7.6	96	64	38	12	0.24	0.0036	<0.0001
San Benito, Tex.	8.3	-----	-----	71	49	17	0.21	0.0007
<i>Compound B,² 200 p.p.m.</i>								
Topeka, Kans.	9.8	6.1	0.076	0.0062	0.0003	-----	-----	-----
Dermott, Ark.	9.5	<0.0001	0	0	-----	-----	-----	-----
Port Isabel, Tex.	7.5	-----	99	107	88	86	78	67
Norwood, Ohio	7.6	92	20	8.6	2.1	0.78	0.017	0.0026
San Benito, Tex.	8.3	54	4.0	0.22	0.015	0.0031	0.0005	0.0001
<i>Boiled tap water</i>								
<i>Compound A,¹ 50 p.p.m.</i>								
Topeka, Kans.	8.3	89	47	26	2.1	0.030	-----	-----
Dermott, Ark.	9.4	0.016	0	0	-----	-----	53	12
Port Isabel, Tex.	7.9	-----	-----	-----	-----	0	-----	-----
Norwood, Ohio	8.7	91	8.3	1.4	0.0003	0	3.2	0.0062
San Benito, Tex.	8.3	-----	-----	20	-----	-----	-----	-----
<i>Compound B,² 200 p.p.m.</i>								
Topeka, Kans.	8.3	11	0.24	0.086	0.0009	-----	-----	-----
Dermott, Ark.	9.4	0	0	0	-----	-----	33	27
Port Isabel, Tex.	7.9	-----	-----	-----	-----	-----	-----	-----
Norwood, Ohio	8.7	3.2	0.0077	0.0005	<0.0001	-----	-----	-----
San Benito, Tex.	8.3	27	3.8	0.57	0.071	0.0064	-----	-----

¹ Alkyl dimethyl benzyl ammonium chloride.

² Para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride.

Table 2. The bactericidal efficiency of Q.A.C. in distilled water containing salts of calcium and magnesium¹

Q.A.C. and salt added	Average pH		Average percentage of <i>Escherichia coli</i> surviving at 22° C. after (minutes)						
	Initial	Final	1/4	1	2	5	10	20	30
<i>Compound A,² 50 p.p.m.</i>									
MgSO ₄ -----	8.1	7.3	102	86	85	22	0.076	0.0014	-----
MgCl ₂ -----	8.9	8.2	-----	90	24	0.10	<0.0001	-----	-----
Mg(HCO ₃) ₂ -----	8.3	8.3	95	29	11	0.85	0.0003	0	-----
CaSO ₄ -----	8.2	7.5	92	90	81	49	2.3	0.011	-----
CaCl ₂ -----	8.3	8.0	-----	103	92	68	6.6	0.022	-----
Ca(HCO ₃) ₂ -----	7.4	7.4	92	80	77	48	8.9	0.0015	-----
<i>Compound B,³ 200 p.p.m.</i>									
MgSO ₄ -----	8.0	7.1	95	70	58	25	7.4	0.86	0.16
MgCl ₂ -----	8.9	7.7	-----	84	64	33	9.1	1.8	0.42
Mg(HCO ₃) ₂ -----	7.8	7.8	88	27	10	1.5	0.28	0.0061	0.0005
CaSO ₄ -----	8.2	7.2	87	51	22	6.6	2.2	0.40	0.084
CaCl ₂ -----	8.3	7.4	-----	59	31	10	3.2	0.58	0.19
Ca(HCO ₃) ₂ -----	7.4	7.4	78	25	12	3.7	1.2	0.16	0.013

¹ All solutions are equivalent to 375 p.p.m. CaCO₃.

² Alkyl dimethyl benzyl ammonium chloride.

³ Para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride.

methods used, there was little difference in the effect of the various salts (table 2). However, the interference of all these salts was significant at the concentrations tested.

Iron

In highly carbonated waters, iron occurs as the bicarbonate according to Foulk (8). Mueller and Seely (10) demonstrated interference with 10 p.p.m. of iron as Fe⁺⁺ ion at pH 4.0 or lower, but they indicated that above pH 4.0 hydrolysis occurs and interference disappears. However, in many farm dairy uses water is drawn and mixed with germicide before hydro-

lysis can take place. Therefore, information regarding the effect of iron in the native state should be of value.

Ferrous bicarbonate was produced and maintained in a closed system under nitrogen washed through 5 successive alkaline pyrogallol traps followed by 1 water trap. Experiments were run with 10 p.p.m. of iron as bicarbonate and, also, with a like amount as bicarbonate that was first oxidized by aeration until the test for Fe⁺⁺ was negative and a Fe⁺⁺⁺ test showed 10 p.p.m. Bactericidal tests in the presence of ferrous bicarbonate were made with oxygen free nitrogen streaming through the flasks,

Table 3. The effect of iron on the bactericidal efficiency of Q.A.C. at pH 6.1-7.0

Q.A.C.	10 p.p.m. iron as	Valence	Average percentage of <i>Escherichia coli</i> surviving at 22° C. after (minutes)				
			1/4	1	2	5	10
Compound A, ¹ 50 p.p.m.-----	{Fe(HCO ₃) ₂ -----	Fe ⁺⁺ -----	26	0.90	0.054	0.010	0.0006
	{Fe(HCO ₃) ₂ oxidized-----	Fe ⁺⁺⁺ -----	0.0072	0.0095	0.010	0	0
Compound B, ² 200 p.p.m.-----	{Fe(HCO ₃) ₂ -----	Fe ⁺⁺ -----	0.26	0.0019	0.0007	<0.0001	-----
	{Fe(HCO ₃) ₂ oxidized-----	Fe ⁺⁺⁺ -----	0.10	0	0	0	-----

¹ Alkyl dimethyl benzyl ammonium chloride.

² Para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride.

above the test mixture, throughout the experiment. With ferrous bicarbonate, initial and final tests from each individual flask showed 10 p.p.m. Fe^{++} and 0 p.p.m. Fe^{+++} . The bicarbonate form was verified by titration. In experiments with ferrous bicarbonate, solutions were clear and colorless at the conclusion of tests. The results show that at pH 6.1 to 7.0 the interference of Fe^{++} is greater than that of Fe^{+++} (table 3).

Effects of Different Waters

Wyoming, Ohio, water originally has a total hardness of 520 p.p.m. and a bicarbonate content of 320 p.p.m. It is softened by lime-soda to a total hardness of 100 p.p.m. and a bicarbonate content of 60 p.p.m. Germicidal interference of this softened water was low, but restoration of the hardness by the addition of calcium bicarbonate resulted in marked interference. Control tests eliminated pH variations as the responsible factor.

Topeka, Kans., tap water was similar to that from Wyoming, Ohio, and likewise caused relatively little interference with compound B (table 1), but it did result in more interference with compound A than was true of Wyoming, Ohio, water. The boiling of Topeka water increased the interference slightly. In this case no mineral was precipitated, but the drop from pH 9.8 to 8.3 was probably a contributing factor.

Table 1 also shows the effect of Dermott, Ark., water (hardness 8 p.p.m. and total mineral content 252 p.p.m.) in which the major part of the mineral content is sodium and potassium bicarbonate (200 p.p.m.) and chloride (27 p.p.m.). Interference was very low in this water. To establish that this lack of interference was not due to the high pH (9.5), tests were run with 375 p.p.m. of sodium bicarbonate in distilled water at pH 7.5 to 7.9 in parallel with tests using raw Norwood water at the same pH. The results clearly indicated that sodium bicarbonate does not interfere under these conditions. These results also showed a marked difference between the interference in Norwood water and that of a synthetic water containing an equivalent concentration of bicarbonate as sodium bicarbonate.

Tests with Cincinnati, Ohio, tap water showed some interference at bicarbonate and total hardness levels of 33 p.p.m. and 94 p.p.m., respectively. Boiling had relatively little effect on this water in which a large percentage of the total hardness is permanent in nature. This is in marked contrast to Norwood water in which 90 percent of the total hardness is present as bicarbonate.

San Benito, Tex., tap water had a total mineral content of 1,150 p.p.m., of which 366 p.p.m. was hardness and a considerable portion of the latter was of the permanent type. Significant interference with germicidal action occurred in this water, and the interference was reduced somewhat by boiling.

Port Isabel, Tex., tap water had a total mineral content of 3,200 p.p.m. and 1,100 p.p.m. total hardness, mostly of the permanent type. This water represents the maximum interference ever encountered in studies with these compounds at the Robert A. Taft Sanitary Engineering Center (table 1). Boiling resulted in very little reduction of interference in this water, as might be expected, since permanent hardness is not affected by boiling.

Exclusion Tests

Norwood water contained a small amount of barium and strontium. No significant interference was noted in tests made with a mixture of barium and strontium bicarbonate in a concentration equivalent to the barium and strontium content of Norwood water.

Norwood water contained about 20 p.p.m. of silicon. Therefore, it was considered desirable to study the effect of this element in distilled water. Foulk (8) states that silica in underground waters is generally considered to be in the form of uncombined silicic acid. Accordingly, silicic acid was added to distilled water to produce a concentration of 20 p.p.m. as silica. The solution was initially adjusted to pH 10.0, using sodium hydroxide, in order to facilitate solution of the silicic acid. Storage overnight resulted in solution of the silicic acid while the pH dropped to 7.3. Because sodium hydroxide was used in the preparation of this water, it is probable that the silica was present as sodium silicate at the time the water was used in bacteriological tests. The ef-

fect of this form of silica on germicidal activity did not appear to be significant under these test conditions.

Boiled carbon dioxide free distilled water containing suspended calcium and magnesium carbonates, equivalent to the concentration of calcium and magnesium content of Norwood water, did not cause significant germicidal interference.

Softening, Sequestration, and Temperature

Raw Norwood water, fresh and stored, seriously interfered with the bactericidal efficiency of compound A (table 4). This interference was significantly reduced by all water treatment methods used. The same general trend was noted with compound B except that whereas the S.H.M.P. reduced the interference with compound A, its effect was negligible with compound B.

In tests at 10° C., 22° C., and 37° C., with all germicide concentrations at the manufacturers' recommended dosage, 200 p.p.m. of active agent, fresh Norwood water was sequestered or softened to the hardness levels shown in table 5. At 37° C. compound A was effective under all test conditions while compounds B and C were effective in the treated water, but some interference was noted in both the freshly collected and stored raw water. In tests at 22° C. there was little interference with the activity of com-

ound A. There was moderate interference with compounds B and C in all treated waters, T.S.P.P. excepted, and marked interference in the fresh and stored raw water. When studied at 10° C. (table 5) the raw water interfered moderately with the activity of compound A and very severely with the activity of compounds B and C. Treatment prevented most of the interference with compound A. However, with compounds B and C interference was marked in all treated waters except those sequestered with T.S.P.P., in which there was moderate interference. However, an impractical amount, more than 2.0 percent, of T.S.P.P. was necessary to reduce the soap hardness to 75 p.p.m. This led to tests with reduced concentrations of T.S.P.P. (table 6).

These data indicate that in the case of T.S.P.P. there was no correlation between the soap hardness and inactivation of interference. Results show that 0.2 percent of T.S.P.P. is reasonably effective in alleviating the interference of Norwood water under the conditions of these tests except in the case of compound C at 10° C. (table 6). This amount of T.S.P.P. had a negligible softening effect as measured by the soap test. In general these results tend to be similar to those noted by Armbruster and Ridenour (11), Elliker (12), and others.

Results presented in table 5 show the effect of treatment with sufficient E.D.T.A. to reduce

Table 4. Effect of treatment on the capacity of Norwood water to interfere with the bactericidal efficiency of Q.A.C.

Water treatment	Total hardness in p.p.m.	pH	Average percentage of <i>Escherichia coli</i> surviving at 22° C. after (minutes)									
			Compound A, ¹ 50 p.p.m.					Compound B, ² 200 p.p.m.				
			1/4	1	2	5	10	1/4	1	2	5	
Fresh raw-----	415	7. 3-7. 9-----	95	78	73	36	73	40	9. 3	1. 3		
Lime softened-----	73	7. 4-7. 592	46	12	0. 12	0. 0003	0. 88	0. 0002	<0. 0001	0		
Zeolite softened-----	73	7. 2-7. 786	45	22	0. 62	0. 0072	0. 76	0. 0002	<0. 0001	-----		
E.D.T.A. treated ³ -----	74	8. 9-9. 173	1. 8	0. 024	<0. 0001	-----	0. 017	<0. 0001	0	-----		
S.H.M.P. treated ⁴ -----	73	7. 3-7. 868	0. 37	0. 0003	0	-----	83	42	22	2. 4		
Stored raw-----	408	7. 6-8. 2-----	95	90	58	36	83	28	4. 5	1. 6		
Distilled control-----	0	6. 6 0. 018<0. 0001	-----	-----	-----	-----	0. 0023	0	-----	-----		

¹ Alkyl dimethyl benzyl ammonium chloride.

² Para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride.

³ Tetrasodium salt of ethylenediamine tetra acetic acid (0.185 percent).

⁴ Sodium hexametaphosphate (0.18 percent). Hardness tested with soap—all others tested by Versenate method.

Table 5. Effect of treatment on the capacity of Norwood water to interfere with the bactericidal efficiency of 200 p.p.m. of Q.A.C.

Water treatment	Total hardness p.p.m.	pH	Average percentage of <i>Escherichia coli</i> surviving at 10° C. after (minutes)								
			Compound A ¹			Compound B ²			Compound C ³		
			1/4	1	2	1/4	1	2	1/4	1	2
Fresh raw-----	410	7.4-7.8	46	4.1	0.65	97	86	78	92	76	71
Lime softened-----	75	7.7-8.0	1.1	0.020	0.0002	52	12	4.9	41	35	7.9
Zeolite softened-----	74	7.7-8.0	0.59	0.0002	0	50	9.9	5.8	34	10	2.6
E.D.T.A. treated ⁴ -----	75	8.9-9.2	0.18	<0.0001	0	32	5.2	3.1	31	13	5.6
T.S.P.P. treated ⁵ -----	77	9.1-9.3	<0.0001	0	0.024	<0.0001	0	2.4	0.0030	0.0018	
Stored raw-----	352	8.0-8.2	42	3.0	0.36	-----	83	-----	0.032	0.0045	62
Distilled control-----	0	6.6	<0.0001	-----	0.0001	<0.0001	-----	0.032	0.0045	0.0003	

¹ Alkyl dimethyl benzyl ammonium chloride.

² Para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride.

³ Alkyl tolyl methyl trimethyl ammonium chloride.

⁴ Tetrasodium salt of ethylenediamine tetra acetic acid (0.185 percent).

⁵ Tetrasodium pyrophosphate (>2.0 percent). Hardness tested with soap—all others tested by Versenate method.

Table 6. The effect of different concentrations of T.S.P.P. on the bactericidal efficiency of 200 p.p.m. of Q.A.C. in Norwood water

Temperature	Percentage of T. S. P. P. in test water	Compound	Average percentage of <i>Escherichia coli</i> surviving		
			1/4 minute	1 minute	2 minutes
10° C.-----	0.10	¹ A	0.64	0.0003	0
	.15	¹ A	0.0005	<0.0001	0
	.20	¹ A	0.0004	0	-----
	.10	² B	4.4	0.44	0.10
	.15	² B	0.16	0.0010	<0.0001
	.20	² B	0.16	0.0008	0
	.10	³ C	69	55	46
	.15	³ C	20	21	-----
	.20	³ C	15	10	-----
	0.10	¹ A	<0.0001	0	0
22° C.-----	.15	¹ A	0	0	0
	.20	¹ A	0	0	0
	.10	² B	0.15	0.0042	<0.0001
	.15	² B	0.0023	0.0001	0
	.20	² B	0.0003	0	-----
	.10	³ C	2.8	0.0090	0.0028
	.15	³ C	0.30	0.0004	0
	.20	³ C	0.067	0	-----
37° C.-----	0.10	¹ A	0	0	0
	.15	¹ A	0	0	0
	.20	¹ A	0	0	0
	.10	² B	<0.0001	0	-----
	.15	² B	<0.0001	0	-----
	.20	² B	0	0	-----
	.10	³ C	0.0007	<0.0001	0
	.15	³ C	0	0	-----
	.20	³ C	0	0	-----

¹ Alkyl dimethyl benzyl ammonium chloride.

² Para diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride.

³ Alkyl tolyl methyl trimethyl ammonium chloride.

the hardness to approximately 75 p.p.m. Additional data were obtained using varying amounts of E.D.T.A. without regard for alterations in hardness or pH. The addition of 0.3 percent E.D.T.A. further enhanced the activity of the Q.A.C. However, control tests indicated that 0.3 percent E.D.T.A. exerted a definite germicidal effect within 10 minutes but not within 2 minutes. Similar controls, with 0.2 percent E.D.T.A., established that there was no bacterial toxicity during a 10-minute exposure.

Data obtained indicate that at a concentration of 200 p.p.m. all Q.A.C. tested are reasonably effective at 37° C. in Norwood water containing 0.2 percent E.D.T.A. In similar tests at 22° C. the efficiency of compounds B and C was fair to marginal while that of A remained good. The latter was the only compound which showed good response at 10° C. in Norwood water treated with 0.2 percent E.D.T.A.

Discussion

The present study was concerned solely with the effect of the mineral content of waters on the bactericidal action of Q.A.C. Therefore, important public health considerations such as viruses, fungi, and the effect of factors like proteinaceous material, residual soap, and other foreign materials were not considered.

In the first part of this investigation, Q.A.C. concentrations were set at levels considered best for determining variations due to different types of waters used. Accordingly, results reported were not, in all instances, obtained under conditions best suited to an evaluation of the various germicides (13). The concluding work in this study was directly concerned with concentrations recommended for use. However, the scope of this investigation made it necessary to limit tests to three chemical types of Q.A.C.

Interference with germicidal action was generally high in waters having high concentrations of soluble calcium and magnesium salts. Any treatment which tended to precipitate, remove, or inactivate calcium or magnesium reduced the interference. Further evidence of the role of these salts was indicated by increased interference when boiled water was recarbon-

ated or calcium carbonate was added to plant softened water, followed by recarbonation.

Waters in which practically the entire mineral content was bicarbonates of sodium and potassium did not interfere. Boiling, which converted much of the bicarbonate to normal carbonate, did not significantly alter the interference pattern in such a natural water.

High mineral content alone did not necessarily result in high germicidal interference. Bactericidal results with Norwood and San Benito water were similar, although San Benito water has a much higher total solids content. The concentration of calcium and magnesium salts in these two waters is similar in quantity but different in type, occurring mostly as the bicarbonate in Norwood water and as the sulfate in San Benito water. This tends to confirm, in natural waters, the results obtained in synthetic waters, namely, that equivalent concentrations of various soluble calcium and magnesium compounds interfere to approximately the same degree. The nonhardness salts in San Benito water were those of sodium and potassium, and did not appear to have contributed to the interference. This finding coincides with the observations noted in tests with distilled water containing sodium bicarbonate, as well as in Dermott, Ark., water. Still further evidence in this regard was indicated by the significant reduction in interference in Norwood water partially softened by zeolite where sodium was substituted for calcium and magnesium.

The effect of temperature is marked, and the trend is similar to that reported by McCulloch and associates (14). At 10° C. all of the compounds at a concentration of 200 p.p.m. showed marked interference in Norwood water.

The analyses of Topeka and Cincinnati water were nearly identical insofar as hardness and alkalinity were concerned. Freshly drawn Cincinnati water interfered with germicidal action somewhat more than Topeka water. The difference in pH could be responsible for the different reactions in these otherwise similar waters. Ridenour and Armbruster (3), Mueller and Seeley (10), and others have shown that the activity of Q.A.C. is enhanced by high pH values. When Cincinnati and Topeka waters were boiled, the pH of Cincinnati water in-

creased while that of Topeka water decreased. This shift was accompanied by a slight decrease in interference in Cincinnati water while that of Topeka water increased somewhat.

Practical differences in the various methods of treating Norwood water were apparent. There was little difference in either the appearance or interference of the lime or partially softened zeolite-treated water at 75 p.p.m. hardness. Both treatments produced sparkling clear water. However, as a final rinse for utensils, lime or lime-soda softened water, due to the marked reduction in total dissolved solids content, should leave air dried glassware in a much more presentable condition than would be the case with zeolite-softened water.

Water treated with E.D.T.A. was clear while that treated with T.S.P.P. was very turbid. Since both of these additives, even though somewhat more effective than lime or partial zeolite softening in reducing interference, increase the total salt content of a water already high in dissolved solids, the effect on air dried glassware and equipment probably would leave much to be desired.

Summary

Many waters interfere with the bactericidal action of quaternary ammonium compounds. In this study hard waters have been shown to interfere seriously. Bicarbonates, sulfates, and chlorides of calcium and magnesium appear to be the primary cause of interference. Ferrous bicarbonate interfered to a moderate degree, but this interference was minimized when the iron was oxidized.

Natural waters in which the bulk of the mineral content was sodium and potassium bicarbonate did not seriously interfere with the germicidal action of Q.A.C. When such waters were boiled, most of the bicarbonates were converted to normal carbonates with no apparent change in interference.

Lime and partial zeolite softening removed a considerable portion of the interference from a hard water used in tests. Tetrasodium pyrophosphate and the tetrasodium salt of ethylenediamine tetra acetic acid reduced the interference of this water sufficiently to offer promise for use in practical applications.

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An Experience in Home Injury Prevention

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AN EXPERIENCE in accident prevention in Richland County, Ohio, known as the home safety notebook project, sought to motivate families to keep a record of injuries in the home. It appears to have demonstrated that such families soon establish safety patterns that perceptibly reduce the rate of injuries.

The project was undertaken by the health committee of the Mansfield Parent-Teacher Association Council in cooperation with the home safety program of the Mansfield-Richland County Health Department. Two major purposes were (a) to test acceptability to home-makers of the methods used and (b) to measure change in frequency of injuries during a 16-week period. In addition, data on type of injury, location and activity of persons at the time of injury, parts of the body injured, and other injury characteristics were to be obtained.

The Mansfield-Richland County Health Department is 1 of 3 local health departments in the Nation carrying on a 5-year home safety program through a grant from the W. K. Kellogg Foundation. The home safety notebook project is one of many projects developed

during the course of this program, which was begun in the fall of 1951.

The Basic Plan

The recording by family members of all home injuries, regardless of severity, constituted the basic plan of action. The record was kept in a calendar-notebook, a booklet designed to facilitate the recording of selected information about each injury. The chairman and co-chairman of the PTA council health committee directed the project, and the chairman of each individual PTA health committee supervised the work of the participants.

The methods used in the project were modifications of those used in the home injury prevention experience conducted by the Washtenaw County Health Department of Michigan (1). In the Washtenaw County experience, public health nurses provided supervision and 95 families participated.

A total of 119 families agreed to keep safety records in the Richland County project. Ten or eleven families were selected from each of the PTA groups or mothers clubs in 10 elementary schools, and 14 families were from the health department staff. Participants were selected on the basis of agreement to cooperate and did not represent a random selection of families in the PTA or in the city.

Before the recording began, all PTA workers were given 1 hour of instruction in objectives and procedures by the health department home safety director. Following this orientation, each chairman visited the families in his group

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and explained to a responsible member, usually the housewife, the objectives of the project, terms used, and procedures for keeping the record. Drills in filling in the notebook were held. The time for starting the records varied within different PTA groups, but all were begun within a 4-week period, in October and November 1953.

On cards furnished by the health department, the health committee chairman recorded the names, ages, and injury data for the families in their group. Approximately every 2 weeks, they contacted the families, by visits to the home, by telephone, or at PTA meetings, to secure or to give information about the project.

During the 16-week period, the health department's home safety director visited each family at least twice. These visits were intended to sustain interest and to secure con-

tinued participation, as well as to answer questions on procedures. The health department maintained close communication with the PTA workers and at various stages of the project sent mimeographed newsletters to the families.

The fact that no families withdrew from the experience indicates that there was substantial interest on the part of those participating. However, the records of 5 families were unsuitable for use in the tabulation of data. One family moved from the area; 1 family's record was destroyed during an intercity household move; 1 record was not usable because of a misunderstanding regarding the completion date; and 2 records were lost or misplaced.

The possibility exists that the family member who recorded the injuries was less conscientious in performing the task toward the end of the study period. However, for several reasons,

Table 1. Injury frequency data, according to sex and age groups

Age and sex groups	Number of persons in study	Number of persons injured, by number of injuries					Total number of persons injured	Percent of persons injured	Number of injuries	Number of injuries per 100 persons	Average number of injuries per injured person
		1	2	3	4	5					
<i>Males</i>											
0-4	21	5	3	1	1	2	12	57	28	133	2.3
5-9	54	20	5	2	0	0	27	50	36	67	1.3
10-14	39	7	4	2	0	0	13	33	21	54	1.6
15-19	13	4	0	0	0	0	4	31	4	31	1.0
20-24	2	0	0	0	0	0	0	0	0	0	0
25-29	9	5	0	0	0	0	5	56	5	56	1.0
30-34	13	1	0	0	0	0	1	8	1	8	1.0
35-39	34	10	1	0	0	0	11	32	12	35	1.1
40-44	26	5	0	0	0	0	5	19	5	19	1.0
45-49	16	3	0	0	0	0	3	19	3	19	1.0
50-54	11	1	0	0	0	0	1	9	1	9	1.0
55 and over	6	0	0	0	0	0	0	0	0	0	0
Total	244	61	13	5	1	2	82	34	116	48	1.4
<i>Females</i>											
0-4	14	4	1	3	0	2	10	71	25	179	2.5
5-9	55	16	6	5	0	0	27	49	43	78	1.6
10-14	44	10	1	1	0	0	12	30	15	34	1.2
15-19	12	3	2	0	0	0	5	42	7	58	1.4
20-24	1	0	0	0	0	0	0	0	0	0	0
25-29	17	7	0	5	0	0	12	71	22	129	1.8
30-34	19	5	3	2	0	1	11	58	22	116	2.0
35-39	31	9	9	0	0	0	19	61	35	113	1.8
40-44	29	8	1	2	4	1	16	55	37	128	2.3
45-49	8	4	2	1	0	0	7	88	11	138	1.6
50-54	5	2	2	0	0	0	4	80	6	120	1.5
55 and over	15	5	0	1	0	0	6	40	8	53	1.3
Total	250	73	27	20	4	4	129	52	231	92	1.9

¹ One person had 8 injuries.

it is believed that the recording of injuries was faithful and continuous during the entire 16 weeks. As noted above, careful observation and close supervision were accorded the project throughout the period. Moreover, many families recorded injuries occurring outside the home as well as those occurring inside the home, and some families continued to record injuries during the several days between the end of the project and the collection of the records.

Conditions and Definitions

Certain conditions were inherent in the plan of this project, and selected definitions had to be imposed on the data in order to tabulate and summarize them.

Selection of the families to participate in the experience was without any known probability basis. Consequently, those selected do not constitute a statistical sample of known design, and there is no basis on which to assume that they were representative of the population of Richland County. In fact, certain characteristics of the participating families—age distribution, for example—would be expected to be at great variance from those of the county's population.

As shown in table 1, there were 244 males and 250 females in the 114 families whose records were analyzed, a male/female ratio of 0.976. This ratio is similar to that found in large population groups. The age distribution of the 494 persons, however, is notably unlike that of the general population in that there are far too few persons aged 0-4 years and 15-34 years. The person-per-family ratio was 4.3, which is well above the national average of 3.5.

Previous research studies of some 2,500 families in Washtenaw County, Mich., had indicated that rates of accidental injuries incurred within homes were relatively homogeneous by rural-urban and family income groups (1). These findings led to the expectation that rates for the Richland County families would simulate those for the Washtenaw County families if the following assumptions were made: (a) family constituency, living conditions, and other socioeconomic factors for the groups were similar; (b) the season of year in which the experiences were accumulated did not influence

the rate; (c) the groups were large enough to reflect the injury rate with relative accuracy; (d) conditions of instruction, motivation, and recording of events were essentially equal; (e) other pertinent factors were similar. Insofar as rates from this experience are found to parallel those from the Washtenaw County experiences, bases may be formed for acceptance or rejection of these assumptions.

Instructions on recording injuries included the following:

1. Record all injuries in the notebook provided by the health department.
2. Record all injuries occurring in your home or in other homes to members of your household, including relatives and others living with you.
3. Record the injury as soon as practicable after it occurs.
4. Give the best answer you can for each item of information requested and be as specific as necessary to be clear.
5. Refer all questions concerning the project to the PTA chairman of your group.

For this project, the term "home" was defined as the dwelling and yard area used for usual home activities. Not included within this definition are public and community playgrounds, parks, and buildings and areas used primarily for agricultural and vocational purposes. Several families recorded all injuries regardless of the place of occurrence, but because they gave the location clearly selection of the home injuries was an easy task.

Each injury was classified by the analysts as major or minor. A major injury was an injury having one or more of the following characteristics: (a) preventing usual activity for 1 hour or more; (b) costing \$1 or more for treatment; (c) receiving professional treatment. Any other injury was classified as minor.

Injury Frequency Patterns

Analysis of the recorded injuries by age and sex shows that males under 20 years of age exhibited approximately the same injury frequency pattern as did females in this age group (table 1). However, the male/female ratio of injuries for persons 20 years of age or over was

approximately 1:5. For all ages, females suffered about twice as many injuries as did the males.

The frequency of recorded injuries among both sexes was substantially reduced during the time of this project, as shown in table 2. The reductions after the first 2 weeks tended toward plateaus rather than regular decrements by time intervals. Graphically, these reductions resemble an inverted learning curve, suggesting that persons in this experience gradually adopted or learned safer ways of home life.

Table 2. Injury frequency data, according to week of participation

Week	Number of injuries, major and minor			Injury rate per person-year	Number of major injuries		
	Males	Females	Total		Males	Females	Total
1st	17	42	59	6.2	0	3	3
2d	10	24	34	3.6	0	1	1
3d	8	15	23	2.4	0	2	2
4th	9	15	24	2.5	1	1	2
5th	8	18	26	2.7	0	0	0
6th	5	18	23	2.4	0	2	2
7th	10	15	25	2.6	0	1	1
8th	9	12	21	2.2	1	0	1
9th	5	12	17	1.8	0	2	2
10th	8	10	18	1.9	1	0	1
11th	5	10	15	1.6	0	1	1
12th	3	11	14	1.5	0	2	2
13th	4	6	10	1.1	1	0	1
14th	2	11	13	1.4	0	1	1
15th	5	8	13	1.4	0	1	1
16th	8	4	12	1.3	2	0	2
Total	116	231	347	2.3	6	17	23

During the first week of the project, injuries were recorded at the rate of 6.2 per person-year. This rate is comparable to the estimated rate of 6.0 in the Washtenaw County research studies and to the rate of 5.5 reported for the week before the recording of injuries began in the county's 95-family experience. Furthermore, the reduction in rate of reported injuries among the Richland County families from 6.2 during the first week to 1.3 during the sixteenth week parallels the change from 6.1 in the first month to 1.2 in the fourth month among Washtenaw County's 95 families.

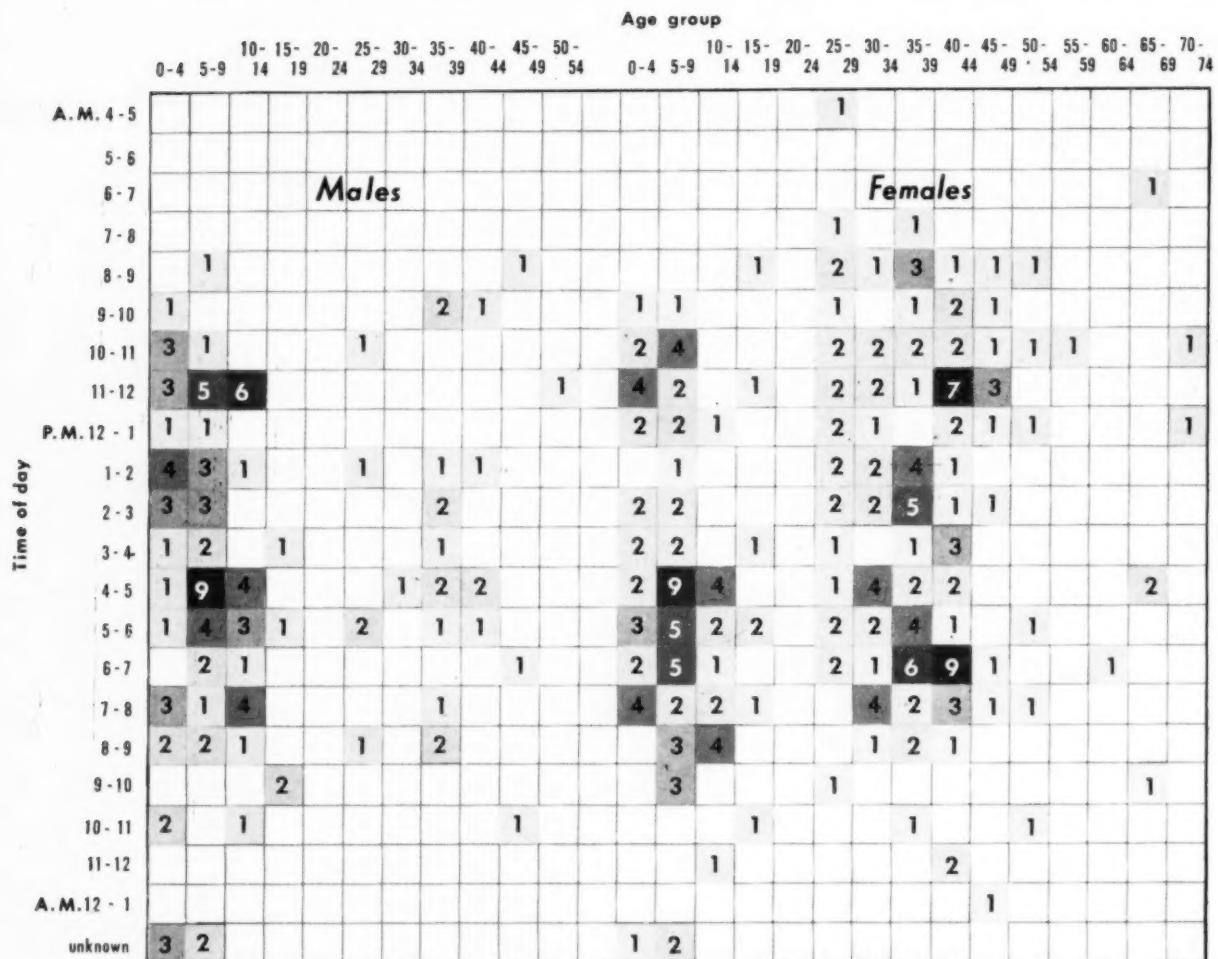
Table 3. Number of injuries in males and females, according to location and activity when injury occurred

Location or activity	Males	Females	Total
Location:			
Inside dwelling unit (exclusive of basement)-----	60	177	237
Basement-----	21	21	42
Outside dwelling unit-----	26	21	47
Other places-----	9	12	21
Total -----	116	231	347
Sublocation:			
Bedroom, nursery-----	9	14	23
Living room-----	19	24	43
Kitchen-----	19	114	133
Dining room-----		10	10
Recreation room-----	5	3	8
Steps-----	5	9	14
Yard-----	14	13	27
Other places-----	25	27	52
Not ascertained-----	20	17	37
Total -----	116	231	347
Activity:			
Playing inside-----	39	36	75
Playing outside-----	13	8	21
Preparing meals-----	3	62	63
Household tasks-----	15	59	74
Walking-----	7	12	19
Walking on stairs-----	3	7	10
Running on stairs-----	3	4	7
Mechanical "do-it-yourself" activities-----	21	9	30
Others-----	11	32	43
Not ascertained-----	1	2	3
Total -----	116	231	347

These similarities in rates are very impressive. The experience in Richland County indicates that interested leaders of club groups with a relatively short period of training and with little expert supervision can make noteworthy contributions in the field of home accident prevention. It also indicates that the home-recording technique might be used profitably on a broad scale within a health jurisdiction by enlisting the cooperation of community organizations.

If injuries had continued at the rate of 59 per week, as during the first week, a total of 944 injuries would have accumulated. The 347 recorded are approximately 600 fewer than might have been expected. Of the 347 recorded injuries, 23 were classified as major injuries. If these had continued at the rate of 3 per week,

Injury occurrences during specified hours of the day, by sex and age groups.



as during the first week, 48 would have been recorded, or at the rate of 8 recorded for the first 4 weeks, 32 would have been reported.

The infrequency of major injuries among the families in this experience argues against drawing any conclusions from the data on these injuries. There appears, however, to have been a trend for reduction in major injuries during the same time that minor injuries were being reduced, at least among the females. Since descriptions of accidental injury occurrences rarely allow accurate prediction of the severity of the injury, programs of prevention may well be aimed at the often recurring events which terminate in minor injuries with the expectation that the number of severe injuries will be reduced concurrently.

Injury Characteristics

Table 3 shows the location and type of activity when injuries were incurred. Predominance of injury to females was accounted for almost exclusively by "preparing meals" and "household tasks" and by location in the kitchen and dining room and on steps. At another season of the year, the yard might be expected to present a higher relative frequency of location, as was the case in the Washtenaw County research studies, and the entire pattern for males might be changed.

Males suffered injury most frequently during the hours of 11:00 a. m. and 1:00, 4:00, and 5:00 p. m. The frequency among females was greatest from 10:00 to 12:00 a. m. and from 4:00 to 8:00 p. m. (see chart). The variations in injury occurrences by hour of the day and by

age and sex groups suggest concentration of preventive effort at specific hours for the different groups. Children under 10 years appear to be injured during the afternoon and evening far more often than during the morning, and the times of highest frequency for adult females appear to be associated with the usual hours of meal preparation or other routine household tasks.

Cuts were the predominant type of injury, and bruises were next in importance (table 4). Burns from hot surfaces occurred approximately six times as frequently among females as among males. Cuts occurred most frequently among adult females; among males, children suffered cuts more frequently than adults. Children of both sexes suffered many more bruises than did their parents. These data provide suggestive bases for specific approaches to prevention, as well as indications for advice regarding first-aid practices.

The upper extremities, especially the fingers and the hand, suffered injury most often (table 5). Tabulations not presented in this paper showed that the injuries to these parts were largely cuts, with bruises and burns next in order. The majority of the difference between the number of injuries to females and the number to males was accounted for by injuries to the fingers and hands.

Table 4. Number of injuries in males and females by type of injury, according to age group

Age group	Cut, laceration, scratch		Pierce, punc- ture		Cut and bruise		Bruise		Burn from hot surface		Burn from fire		Other acci- dents		Total	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
0-4	12	8	1	0	3	4	11	11	1	2	0	0	0	0	28	25
5-9	20	25	1	2	2	2	9	12	0	1	1	0	3	1	36	43
10-14	9	7	2	0	2	2	4	5	2	0	1	0	1	1	21	15
15-19	3	3	0	0	0	0	0	0	2	0	1	1	0	1	4	7
20-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-29	4	14	0	1	1	2	0	3	0	1	0	1	0	0	5	22
30-34	0	12	0	1	0	1	1	2	0	4	0	0	0	2	1	22
35-39	5	16	1	2	1	2	0	0	2	11	1	0	2	4	12	35
40-44	3	25	0	0	0	0	2	2	0	8	0	1	0	1	5	37
45-49	3	3	0	0	0	0	0	1	0	3	0	0	0	4	3	11
50-54	0	2	0	0	0	0	0	2	1	1	0	0	0	1	1	6
55 and over	0	3	0	0	0	0	0	3	0	2	0	0	0	0	0	8
Total	59	118	5	6	9	13	27	43	6	34	4	2	6	15	116	231

Table 5. Number of injuries in males and females, according to part of the body injured

Part of body	Males	Females	Total
Head, skull, hair, temple	10	11	21
Face, cheek, lip, forehead, eyelids, eyelashes	9	14	23
Eye	3	2	5
Nose	3	0	3
Mouth, teeth, tongue, gums	2	0	2
Jaw, chin, neck	0	2	2
Chest, ribs	1	2	3
Arm	3	11	14
Elbow	1	2	3
Hand, wrist	14	24	38
Finger, thumb, knuckle	50	127	177
Hip, abdomen, groin, buttocks	1	3	4
Knee	9	7	16
Leg, shin, thigh	4	8	12
Ankle	1	3	4
Foot	2	7	9
Toes	0	1	1
Back, spine	0	2	2
Multiple parts	3	5	8
Total	116	231	347

Responsibility for the injury was attributed to the injured person for 77 percent of the injuries to females and for 67 percent of those to males (table 6). Assignment of responsibility for an accidental injury is, of course, a difficult task. Adults and older children were usually considered responsible for their own injuries. For 24 injuries to children, the mother was

Table 6. Number of injuries in males and females, according to responsibility for injury

Responsibility for injury	Males	Females	Total
Same person as injured	78	177	255
Child or sibling under 5 years	1	2	3
Child or sibling over 5 years	11	9	20
Mother	9	15	24
Father	0	1	1
Both parents	4	2	6
Spouse	1	1	2
Neighbor or visitor	2	1	3
Other persons, including manufacturers	1	0	1
Objects	1	0	1
More than one classification or responsibility	2	8	10
Nothing or not ascertained	5	13	18
Not recorded	1	2	3
Total	116	231	347

listed as the person responsible, but only one father was thus implicated. Both parents were responsible for 6 injuries to children.

The most common action taken when females were injured was "change in performance of household task"; for males the most frequent action was "safety instructions to person injured" (table 7). A nonspecific category composed of such terms as "being more careful" and "being more thoughtful" was recorded for 19 injuries to males and 50 to females. "Correction of environment" was recorded for 43 of the 347 injuries. These data suggest that about 90

percent of the injuries could be attributed to practices and personal action, since for only 12 percent was the environment changed. However, the data may indicate that few persons in the home are capable of interpreting the role of environment in accident causation and of making environmental changes for prevention of injuries. The records showed that most participants seriously attempted to provide information concerning action taken to prevent similar injuries, and perhaps the recording of such information helped in developing safe practices and improving the safety of surroundings in the home.

Summary

In a home accident prevention project in Richland County, Ohio, the rate of injuries per person-year for 114 families was reduced from 6.2 during the first week to 1.3 during the 16th week. This finding, which parallels the reduction reported in a similar project in Washtenaw County, Mich., suggests that the recording of injuries by families may be a method useful in establishing safety patterns in the home, as well as in collecting epidemiological data.

Co-sponsored by the Mansfield-Richland County Health Department and the Mansfield Parent-Teacher Association Council, the project demonstrated a cooperative approach between an official health agency and a civic organization. The fact that no families withdrew indicates that interest in the project was sustained throughout its course.

The procedures used were both economical and practicable and could be applied in any community. They might be used profitably on a broad scale within a community or health jurisdiction.

The data obtained concerning several characteristics of accidental home injuries add to the steadily accumulating information on this problem. Such data are essential for sound planning and operation of home accident prevention programs.

REFERENCE

- (1) Investigation and application of home injury survey data in development of prevention procedures. Ann Arbor, Mich., University of Michigan School of Public Health, 1953.

Table 7. Number of injuries in males and females, according to action taken to prevent similar injuries

Action	Males	Females	Total
Safety instructions to person injured	34	36	70
Safety instructions to self (when injured)	1	8	9
Safety instructions to others than persons injured (as well as to person injured)	6	3	9
Correction of environment	12	31	43
Change in performance of household task	21	68	89
Improvement in supervision of children	4	3	7
General resolve to be more careful	19	50	69
More than one action	0	1	1
Nothing	13	22	35
Not ascertained	6	9	15
Total	116	231	347

Local health officers are offered an idea that may strengthen nutrition education for food buyers at the "point of sale."

Nutrition at the Shopping Center

By WILLIAM H. SEBRELL, Jr., M.D.

THE nutritional quality of diets in this country has improved steadily since World War II. Yet there are further opportunities ahead. Just because we can say that the average man in the United States today obtains enough food to prevent serious deficiency disease does not mean that he is obtaining enough food of the right kind to give him optimum health, to help his children grow at their best rates, to prevent chronic disease, to protect him against the added stress of a severe illness, or to give him the extra stamina needed to produce to capacity in today's intensely competitive world.

We do not have widespread serious deficiency disease any more—but this is no reason to be complacent. Let's look for a moment at a form of malnutrition that affects at least a quarter of our population. I refer to obesity. Health officers and physicians are waging a ceaseless war against this condition.

Sellers of food, too, have a very real interest in this form of malnutrition as well as all other forms—not only a humanitarian interest, but a business interest. The fat man is fat because he eats too much; the remedy is to get him to

reduce his calorie intake until he uses up his own excess fat. Is it better business to sell him 3,500 calories as 2 pounds of sugar or to reduce his calories to 2,700 by selling him 2 pounds of sirloin steak? Or to look at the problem from another angle: If he is seriously overweight, he may die as much as 10 years earlier than he would if he were normal weight.

Common Nutrition Deficiencies

Many remember the food business in the southern States about 25 years ago, when deficiency disease was widespread and the nutritionally sick, and incapacitated largely bought molasses, grits, fatback, and collards. Compare that with the food business of the south today. Florida has become one of the great cattle raising States. We see increased livestock and dairy farming and more fruit and vegetable production all over the south.

One of the greatest needs today is better nutrition education. In a survey by General Mills (1), covering nearly 60,000 children in 38 States, it was found that diets tend to become poorer as children grow older; that 52 percent of high school girls' diets were poor; that the diets of boys were notably deficient in fruits and vegetables; that the adequacy of the child's diet relates closely to the occupation and economic status of the parent; and that adolescent girls drink far too little milk in the belief that it is fattening.

Dr. Sebrell, director of the National Institutes of Health, Public Health Service, presented this paper, condensed here, at the National Food Conference, Hollywood, Fla., March 3-6, 1955.

In a study by the agricultural experiment stations of six northeastern States (2), conducted in 1952, the diets of pregnant women, industrial workers, and students from kindergarten through colleges were judged by the same standards. The most common and serious deficiency was vitamin C; deficiencies in calcium and vitamin A also occurred frequently. In a 5-year Iowa statewide project by Dr. Eppright of Iowa State College (3), a deficiency of calcium and vitamin C was found. Most conspicuous for poor diets were the teen-age girls—a situation cited as particularly alarming because of its potential effects on the next generation. In New York State, Trulson (4) examined 3-day diet records of 10,000 children, half of them in the fourth and half in the tenth grade, and found the poorest food practices among the older girls.

Another group suspected of prevalent nutritional inadequacy is the older population, people over 65—a group which has increased twice as fast as the total population since 1900. Nutrition science, using new biochemical approaches, offers much promise against the diseases of the later years. In the aged, poor diets may result from psychological, social, or mechanical difficulties. About four-fifths of this age group live with relatives. At the family table, the aged may be handicapped by dental and digestive difficulties, and even their status with the family may affect their diet. Sometimes their nutrition is poor because of habits acquired in early life. These habits are not easily changed, and their modification must be approached with caution. Wisdom, tact, and patience are needed to promote good nutrition in this group and must be applied in all educational programs, whether the physician, nutritionist, or a public advertisement conveys the information.

Education in the Food Store

Nutrition education is the essential link between professional knowledge and the improvement of food practices. It seeks to establish public understanding of, and demand for, a food supply adequate for optimum health—a balanced consumption of nutrients—taking into account a wide range of incomes. The physi-

cian, the nutritionist, the health officer, the scientist, and the teacher are struggling with limited resources and limited opportunity to teach good nutrition to the individual.

The housewife learns from these sources that good nutrition can help make her pregnancy successful, her baby healthy, and its growth good—that health, vitality, and long life are not attainable without good nutrition. It is usually her responsibility to buy the food for her family. And where does she make this final day-to-day decision? Frequently in the food store and the market. And what guidance does she get at the point of sale to help make her purchases fit with what she has been taught? None. And what help does she get to satisfy her that she is carrying out her responsibility? None. She is faced with a new set of values as she walks through the market deciding what she will buy—a comparison of prices, of sizes and weights, of quality, beautifully, colorfully, and as effectively done as modern sales techniques can do. But she receives no guidance whatever.

Let me point out where we have failed. I have just mentioned the extensive studies that have shown deficiencies in vitamin C, calcium, and vitamin A. Most food sellers would know what foods to tell families to buy in the store to combat these deficiencies. But they are missing a great opportunity for using that knowledge.

Many millions of dollars every year go into the pockets of food faddists with special food items to sell—items that may range from dried seaweed to blackstrap molasses supposed to possess extraordinary food values of some kind. The success of the food faddist in recent years is an indication of our partial failure in sound nutrition education for the general public. The food faddist's methods are insidious, yet effective. As a lecturer, a pamphleteer, a propagandist, he sells the story that the American diet is deficient, that many common foods are harmful or dangerous, that malnutrition is widespread, that most of us suffer some ailment as a result, that we must radically change our diets to regain health and to avoid disease in the future—and, of course, we must use plenty of his special food items.

It is hard to believe that so transparent an argument could be successful, but it has been.

The regulatory agencies such as the Federal Trade Commission, the Food and Drug Administration, and the Post Office Department are doing what they can to control false and misleading advertising. But the only permanent answer is a planned education campaign—one that teaches by truth, logic, and repetition the correlation between food, nutrition, and health.

If we could educate the people in the fundamentals of good nutrition, they could be led to spend their money on good food in the market and on proper dietary supplements that would do them the most good.

Many outlets are now being used to good purpose, but we are failing to use one of the best avenues for putting the message across where it really counts—where food is displayed and sold.

We will never have a really successful program until the food sellers and the food industries cooperate with the scientists, nutritionists, and teachers in developing a positive, aggressive, coordinated program to present basic nutrition facts clearly and simply to the Amer-

ican housewife, so that she can use those facts at the point of sale for the best nutrition for her family.

I am sure that if some such plan could be evolved it would prove to be good business practice and at the same time make a significant contribution to public health.

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- (2) University of Rhode Island Agricultural Experimental Station: *University of Rhode Island cooperative nutritional status studies in the northeast region. IV. Dietary findings. Northeast Regional Publication No. 11. Bull. 319*, Kingston, The University, June 1952.
- (3) Practice of public health, 1954. [PHR conference report of the 82d annual meeting of the American Public Health Association, Buffalo, N. Y., Oct. 11-15, 1954] *Pub. Health Rep.* 70: 177, February 1955.
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Housing Rehabilitation in Disasters

The Department of Health, Education, and Welfare has recently developed jointly with the American National Red Cross a plan by which commissioned engineer officers of the Public Health Service will assist the Red Cross in emergency housing rehabilitation activities at times of natural disasters.

Red Cross rehabilitation of buildings damaged by disasters requires on-the-spot assessment of the damage, estimates of costs of restoration, preparation of specifications for restoration, arranging for bids from contractors, and inspection and certification of the contractor's work. The Red Cross maintains a permanent staff of 10 regional building disaster experts, plus a small reserve. The Public Health Service will at times of disaster assign to the Red Cross reserve sanitary engineer and sanitarian officers competent in the

housing field. A few regular officers also will participate. All reserve officer participation will be on a voluntary basis.

The Public Health Service will develop, as a "housing component" of its inactive engineer reserve, a group of from 50 to 70. Approximately 20 will be selected for assignment to a 10-day training course in August 1955 on housing construction, cost estimating, and Red Cross policies and procedures. All members of the housing component of the reserve will periodically receive information on the subject of emergency housing rehabilitation from the Red Cross and Public Health Service. Also, additional training courses will be provided.

The Red Cross will pay all travel and per diem costs for participating PHS officers for training or for disaster relief work.

Practical Problems in Rabies Control

At the annual meeting of the American Public Health Association in Buffalo, October 11, 1954, the Conference of Public Health Veterinarians held a panel discussion on recent advances in rabies control. Current methods and problems in rabies control were touched on through a simple and effective device which gave the discussion unity—the story of the prevention of an imaginary rabies outbreak in an imaginary country. The essentials of the discussion follow.

KOPROWSKI: The events forming the basis for discussion during the present session occurred in June 1954 in the State of Simona of the Republic of Neutralia. I may add that Neutralia (with thanks to Evelyn Waugh) is imaginary and composite and represents no existing nation.

Two large dogs attacked a group of 13 children returning from school. Although all the children came into contact with the animals, some suffered only minor wounds or scratches, while severe wounds of the head and neck were inflicted by the biting animals on other children. Passersby and school teachers, alarmed by this savage and unprovoked attack, called police. Several policemen appeared on the scene immediately, and, as Neutralia permits the carrying of firearms, one of the men shot one of the biting dogs through the head because the animal could not be subdued. The other dog was taken into custody.

Before we start our discussion of these events, I would like to acquaint you briefly with the State of Simona. It comprises an area of 45,000 square miles of land and about 1,500 square miles of inland water.

Farm acreage accounts for about 65 percent of the land area, and

many farm and domestic animals are kept, including large stocks of dairy cows. In the 25 percent of the country covered by dense forest, there is an abundance of wildlife—foxes, coyotes, beavers, wolves, deer, and so forth. Bats are also quite prevalent in this woodland as well as in the inhabited parts of the state.

Simona has a democratic, progressive government and a well-organized department of health and animal husbandry in the capital. The population of 12 million inhabitants is known for its fondness for domestic pets, particularly dogs, and there is, therefore, a large dog population.

Simona was supposed to be free from rabies during the period 1946-54. However, in all adjoining territories, and particularly in the neighboring State of Granchester, the disease had always existed in enzootic form so that the danger of infection being introduced was constantly present.

Now, after giving you this incomplete and sketchy information concerning the State of Simona, I would like to return to the accident which befell the children and ask the members of the panel some questions.

Did the policeman who shot the dog through the head act wisely?

What should have been done with the living dog? Dr. Tierkel?

On Clinical Evidence

TIERKEL: It's too bad the policeman shot the dog through the head. He should have shot him through the heart since shooting through the head damages the brain and makes it less useful for diagnosis. The dead dog's head should be sent to the laboratory for examination for Negri bodies.

If it is possible to capture the biting animal, the apprehended dog should be watched for 7 to 10 days by a qualified observer to see if the animal shows clinical signs of rabies.

Most important, the captured dog should be allowed to die a natural death from the disease if he has it in order to increase the chances that his brain, on examination, will disclose fully developed Negri bodies.

The head should be removed, packed with ice in a watertight double container and sent to the public health laboratory by the fastest means of transportation. It should not be frozen because freezing often distorts and tears the structure of the tissues, making the examinations difficult.

Panel Members

Moderator of the panel discussion on rabies control was Dr. Hilary Koprowski. He is assistant director of viral and rickettsial research for the research division, American Cyanamid Company, Pearl River, N. Y.

The panel members were: Dr. Donald J. Dean, veterinary consultant, New York State Department of Health; Dr. Leland E. Starr, public health veterinarian, Georgia State Department of Public Health; and Dr. Ernest S. Tierkel, director, Rabies Control Activities, Communicable Disease Center, Public Health Service, Atlanta.

Also participating, toward the close of the discussion, were Dr. John P. Fox, professor of epidemiology, department of tropical medicine and public health, Tulane University of Louisiana School of Medicine; and Dr. T. F. Sellers, director, Georgia State Department of Public Health.

Of course, absence of Negri bodies in the brain does not conclusively prove that the dog is free from rabies. If there are no Negri bodies, one grinds up samples from various parts of the brain in a 10 percent suspension and injects this into the brains of mice to see if these test animals will become infected.

In practice, 10 to 15 percent of routine Negri-negative canine brains turn out to be positive on the mouse tests. It's a good idea to do a general autopsy of the dog but not if it delays shipment of the head to the public health laboratory.

Another point—the submaxillary salivary glands should be dissected from the head and shipped to the laboratory so that a test can be made for the presence of rabies virus in the saliva. Again, that is done by inoculation of a 10-percent suspension of the salivary glands into mouse brain. To preclude other encephalitides, a serum neutralization test is made with the virus isolated in mice. This procedure definitely establishes whether rabies is present.

DEAN: Fifteen to twenty-five percent of the dog heads examined annually in upstate New York prove rabid. Diagnosis is made in 95 to 98 percent of the rabies cases through finding typical Negri bodies in impression smears or sections of

the dog's brain. The remainder are established as rabid by mouse inoculation tests. All street virus strains isolated in New York State to date have been negrigentic. Fixed rabies strains, on the other hand, early lose the ability to produce Negri bodies.

KOPROWSKI: Some African strains of rabies virus do not elicit formation of Negri bodies.

DEAN: Another problem in diagnosis is the presence of inclusions similar to Negri bodies when rabies doesn't exist—false positives. These structures are artifacts or inclusions associated with other viral diseases. They are particularly common in cats and raccoons. This is important since with hyperimmune antirabies serum decisions on human treatment have to be made earlier.

KOPROWSKI: The necessary steps, then, in determining whether rabies is present in a biting animal may be briefly outlined:

First, a period of observation by a qualified observer.

Second, general autopsy when the animal dies or is killed following clinical signs of rabies, with the use of good pathological procedures.

Third, shipment of the head, packed in ice but not frozen, to a suitable laboratory; or shipment of brain tissue and salivary glands, in glycerol-saline solution.

Fourth, laboratory diagnosis with (a) proper staining to reveal the pathognomonic Negri bodies, which are sometimes hard to differentiate from nonrabies inclusions; (b) the inoculation of mice with brain suspensions which have been treated with penicillin or streptomycin, the observation of mice for sickness or death, and the examination of mouse tissues for Negri bodies; and (c) accurately performed serum neutralization tests.

Following these procedures, one of the biting dogs in Simona was diagnosed as suffering from rabies, and in all probability his saliva at the time of the attack upon the children was infectious. We shall return later to the outline of treatment of the children.

Meanwhile, we have to report regretfully that within 2 weeks several more confirmed cases of rabies in dogs were reported from other areas of Simona. After that the spread was rapid, and the disease was not confined to dogs. By the end of September the following cases of rabies had been recorded: 79 dogs, 14 cattle, 8 cats, 2 horses, 3 sheep, 7 foxes, and 1 deer. Almost all counties of the state were affected. What control methods were to be adopted by the State of Simona Public Health Department?

On Dog Vaccination

DEAN: There are two problems: canine rabies, to be solved by vaccination and dog control, and the more complex problem involving rabies in wildlife and farm and domestic animals other than the dog.

Dog control should obviously be tightened although this is difficult to achieve in rural areas. One should next vaccinate as many dogs as possible so as to impose a barrier of immune dogs between infected wildlife and man. Experience has shown that if 70 percent of the dog population is vaccinated, rabies can be controlled.

Two effective vaccines are available. One contains killed virus produced in mammalian brain tissue; it will afford protection for 1 year.

The other, the Flury strain of modified live virus rabies vaccine, produced in embryonated hen's eggs, protects for 4 years, and possibly for life. We have had extensive field experience since 1946 with both types of vaccine.

In upper New York State, where wildlife rabies is endemic in approximately one-third of the area, and where 314 to 1,175 laboratory confirmed cases have been reported annually since 1944, canine rabies has been dramatically controlled since the dog program was initiated early in 1946. We had 233 rabid dogs in 1944, 503 in 1945, and 377 in 1946, the year our control program started. Since then we have had only 16 to 48 annually despite the widespread and continuing wildlife infection.

From 1946 through 1949, brain tissue vaccine was the only product available for rabies prophylaxis. Its use declined during 1950 and 1951. In this period the attack rate for nonvaccinated dogs was 3 to 11 times as great as that for dogs vaccinated with killed virus rabies vaccine.

The modified live virus vaccine was first used in two of our counties in 1950. Its use grew steadily. It has been the only vaccine used in all county vaccination programs since 1952.

The greatest advantage of the modified live virus vaccine is that it confers more profound and more enduring immunity than the killed virus product. We have had fewer vaccination failures.

Of the rabid dogs reported in up-state New York since the rabies control program started in 1946, 82, or 13 percent, of the dogs were previously immunized with brain tissue vaccine. Of these animals, 52 died of rabies more than 1 month but less than 3 years after vaccination. In contrast there have been only 2 vaccination failures and 1 vaccine death among the 200,000 dogs that have been given the chick embryo product.

It is more effective and cheaper to vaccinate individual dogs every 4 years. Successful annual vaccination is difficult to achieve, particularly in areas where rabies does not exist or where infection is minimal.

Another advantage of modified live virus vaccine is that it appears to be safer for injected dogs. Most of us have witnessed untoward neurological side reactions in occasional animals given the killed virus vaccine. In the absence of controlled studies the exact incidence is unknown, but it is probably in the order of 1 to 3,000 or 1 to 5,000 animals injected.

It should be said, however, that many practicing veterinarians have vaccinated thousands of dogs with brain tissue vaccine without observing serious untoward effects. In our experience, neurological side reactions attributed to modified live virus vaccine have been limited to the death of 1 young puppy and 1 cat.

TIERKEL: Puppies should be vaccinated as early as 2 months of age, and they should be revaccinated at 1 year of age.

Two other countries besides the United States have done mass vaccinating with chick embryo vaccine, Israel and Malaya.

In Israel the jackal was the wild animal vector. Israel, like Simona, is surrounded by rabies-infected countries.

Israel got rid of rabies when it vaccinated all dogs and reduced jackal populations by poisoning campaigns.

Malaya was not able to get rid of rabies over years of trying phenolized, killed vaccine in local areas. But now that the country has carried out a well-organized national campaign with chick embryo vaccine, rabies has been wiped out.

On Registration and Licensing

KOPROWSKI: Now that we have discussed vaccination, we should take up the problem of registration and licensing of dogs as one of the methods of control.

TIERKEL: Registration and licensing of dogs is not the most important rabies control measure. It is basically a method for financially supporting rabies control work. It identifies the animals in the community and gives owners a sense of

responsibility for their live property. Many areas make vaccination a prerequisite for a license. Still others combine vaccination and licensing in a single operation. The latter is ideal because it entails only one trip for the dog owner, one clerical operation all around.

DEAN: We favor permissive county legislation making vaccination a prerequisite for licensing in rabies-infected areas or in areas adjacent thereto. We agree, however, that effective rabies control can be achieved without linking vaccination to licensing.

STARR: In Georgia we have no State licensing of dogs, but Atlanta has had dog licensing as a city. In Atlanta dogs are vaccinated when they are licensed. However, the number of dogs licensed has been too small to reduce materially the incidence of rabies.

In 1952, vaccination clinics were set up by the city health department at a cost of \$1 a dog, but the response was disappointing. Then in 1953, in desperation, the county paid the whole cost and made dog vaccination free. We put on a big ballyhoo—radio, television, loudspeakers on trucks. The veterinarians vaccinated their usual number, but the dogs came in. There are some things I don't like about free vaccination, but it got the dogs in.

On Roundup of Strays

KOPROWSKI: What should be done about stray dogs?

STARR: Rounding up stray dogs requires shelters, rolling equipment, staff. It is a public health problem.

TIERKEL: The roundup of dogs is a public health problem; it should be carried out by dog control men in uniform who are regarded as members of public health teams, not by dogcatchers who are regarded as looking for fees. The dog control men might also be invited to talk to school children on the diseases of dogs, proper care of pets, and importance of rabies control.

STARR: There is a big stray dog problem in Georgia. People have

lots of dogs, but they won't take responsibility for them. It's their dog until they have to vaccinate it.

In Atlanta about 12,000 dogs are always inoculated by private veterinarians. These are well-kept dogs which probably don't have rabies anyway. When dogs are rounded up for vaccination, the irresponsible owners hide their dogs when the truck comes along. They will, however, bring their dogs for vaccination if it's free. When dogs were finally vaccinated free in Atlanta in 1954, there were all kinds of dogs, ill-nourished, diseased, mangy dogs, dogs which should have been destroyed, but what can we do?

There is also a wild dog problem in Georgia—packs of wild dogs running around. The solution to the wild dog problem is to get people interested in getting rid of them.

KOPROWSKI: We want to talk later about wildlife rabies. Before that, I would like to ask whether the panel thinks leashing laws are effective? Dr. Dean?

DEAN: Leashing laws are needed in heavily populated areas to protect the public against dog nuisances. Leashing laws are important whether rabies exists in the area or not. The restraint of dogs, however, is not the most important aspect of rabies control. For example, only 10 percent of the rabid dogs in up-state New York are strays.

KOPROWSKI: Two other points should be mentioned in connection with rabies control in dogs. They are: first, the compulsory reporting of suspicious symptoms and deaths of animals, and, second, the building up of a good diagnostic service.

I think that all members of the panel agree that these are important parts of the framework of a rabies control program. But there is another very important part—the reduction of rabies in wildlife.

On Wildlife Control

DEAN: Wildlife control is the third and most difficult leg of a rabies control program. (First is dog vaccination, second is dog control.) Our knowledge of rabies in wildlife is

scanty. Reporting in wild animals is improving but is obviously sketchier than reporting in dogs and cattle. In New York State we have had rabies in dogs since the early colonial era, but only recently have we recognized the disease in wildlife. We do not think that the upsurge in wildlife rabies is just a matter of better reporting. We think there has been an actual increase. Just why is the \$64 question.

Wildlife rabies has a bizarre epidemiological and geographic pattern. For instance, skunk rabies is endemic in Iowa but appears to be spreading to other areas, such as the Dakotas. In the northeastern States, the fox is the principal vector of rabies.

In New York we know that wildlife rabies not only rises and falls with fox populations but also that foxes can be thinned out by trapping, bounty payments, and poisoning. Experience suggests that reductions of the fox population to one fox a square mile will reduce vulpine rabies. Present techniques for controlling wildlife, principally trapping and den gassing, are too expensive for widespread economical use.

Poisoning offers hope for the future, but there is the problem of species selectivity. After all, one does not want to poison dogs and domestic animals indiscriminately and to expose children to unnecessary hazards. Our conservationists are actively exploring the use of species selective baits. We confidently believe that our canine rabies problem will disappear once wildlife rabies has been eradicated.

STARR: Trapping certainly works, especially if you have dog vaccination too. But you must have community support. In one Georgia county we poisoned. Cattlemen put out eggs, hamburger, and wieners with strichnine. The bait disappeared, but we didn't find any dead foxes.

Pennsylvania spent \$116,000 poisoning in 16 counties. The incidence of rabies fell, but we don't know whether the poisoning did it or not.

KOPROWSKI: There is something important to rabies control, both in wildlife and in domestic animals,

which we haven't touched upon, and that is publicity. The public must be kept informed of its responsibility.

The rabies control measures which have been described may be summarized briefly as follows:

First, the vaccination of at least 70 percent of the dog population, compulsory if necessary, since other control measures without vaccination have proved unsatisfactory.

Second, elimination of strays through registration, licensing, and restraint of dogs.

Third, reporting of suspicious symptoms and deaths and the building up of adequate diagnostic services.

Fourth, the reduction of wildlife species by poisoning, trapping, shooting, and so forth.

Fifth, a publicity campaign designed to make the public aware of the importance of the above measures.

On Vaccination of Animals

KOPROWSKI: Now, I would like to have the members of the panel discuss briefly the vaccination of animals other than dogs, chiefly cats and cattle, since they, too, were involved in the epidemic in Simona.

TIERKEL: We didn't include cats in our mass vaccination programs. Private owners can vaccinate cats. We find that rabies in cats disappears when dog rabies is under control.

DEAN: This is undoubtedly true where only canine rabies exists. Our experience indicates that cat rabies is associated with the disease in foxes.

KOPROWSKI: What about the vaccination of cattle?

STARR: Loss of cattle as a result of rabies was so heavy in Georgia that the State legislature considered free vaccination of cattle.

We tried chick embryo vaccine on test herds. On the last round, we inoculated 19 herds in a rabies endemic area, leaving 25 percent unvaccinated for controls (1,107 animals inoculated in all), but since none of the animals were attacked

by rabies, the experiment was inconclusive except to show that on this round the avianized rabies vaccine did not harm the animals.

We then purchased cattle, inoculated them, and challenged with rabies. Five of the 16 vaccinated cows died, but 12 of the 16 unvaccinated cows died of rabies.

It should be noted that the 5 deaths occurred in animals which had been vaccinated as calves. All animals vaccinated as adults survived challenge. This indicates that the immunity induced is not as solid in young adults and that young animals should be revaccinated.

KOPROWSKI: While all these control measures were being discussed in Simona, rabies spread through wildlife species to an alarming degree. In two places bats were reported to have attacked children. However, before we go over to the bat problem, it is perhaps advisable to discuss a comprehensive program of ecologic studies aimed at elucidating the following points:

How many species are involved?

Is there a possibility of silent carriers?

Do all animals infected with street virus die?

TIERKEL: As Dr. Dean has mentioned, one of the first problems we must attempt to solve is a quantitative relationship between population density of wild animal vectors, such as foxes, and prevalence of the disease in those populations. We must find the population density threshold which will no longer support a rabies epizootic.

The bizarre geographic and cyclic pattern of sylvatic rabies outbreaks has suggested to some the possibility of a symptomless carrier state in foxes and skunks. Along this line, information must be obtained on whether there is natural immunity and recovery in these animals.

Still others feel that there may be unknown reservoirs of rabies in the wild, such as in various species of small mammals which may have been overlooked. This also suggests a possibility that there may be other routes of transmission in wild animals.

Other problems which should be studied are velocity of the geographic movement of infection and the relationship of bat rabies to the disease in terrestrial animals.

On Bat Rabies

KOPROWSKI: What about bat rabies?

The two bats which were caught in Simona after attacking children were forwarded to the nearest public health laboratory and subjected to diagnostic studies. Mice inoculated with their brain or salivary gland tissue developed rabies.

TIERKEL: Many bat species are turning up rabid. It started in 1953 when a Florida yellow bat attacked a child. Then in Pennsylvania a woman was attacked by a different species of bat. These episodes aroused the interest of public health workers in many areas and prompted surveys throughout the country.

Thus far, rabid bats have been found in Florida, Pennsylvania, Texas, California, and Montana. Over 40 isolations have been made from 6 different species of insectivorous bats of free-living and colonial or cave-dwelling varieties.

In Texas, Lt. Col. Kenneth F. Burns reports that 65 percent of 207 pooled bat serums showed rabies antibodies by serum neutralization test. There is much research work that needs to be done to determine the epidemiological significance of these findings.

KOPROWSKI: It's hard to recognize rabid bats since we don't know what to expect in the behavior of a normal bat. According to Colonel Burns, it's hard to distinguish the way bats act when rabid from the effect of DDT, which also affects the nervous system.

Are insectivorous bats as great a menace to the animal population as the hematophagous species?

Is there evidence for symptomatic carriage in bats?

TIERKEL: We do not have enough clinical experience with bats so we must rely on laboratory findings. It has been observed that when vampire bats in Latin America are rabid they often fly in the daytime instead

of at night. On the other hand, vampires are capable of transmitting rabies to people and animals without showing visible signs of illness. We have yet to discover whether this is true of the rabid insectivorous bats found in the United States.

DEAN: Anything we say about the bat problem is premature. We first thought that only free-living bats were infected but then found rabies in colonial bats as well.

There are two schools of thought. One group thinks that bat rabies in this country represents an extension of the disease from Mexico, Trinidad, or South America, the invasion of a new disease among bats in the United States. Rabies among vampire bats south of the border is an old problem. In this connection migratory bats have been tagged traveling as far as 800 miles. There is a banding program under way to check this. Another group feels that rabies in bats has existed in this country for many years. Knowledge concerning bats and bat rabies is grossly inadequate.

We note that there is an unusually long incubation period in bat rabies with the Florida experience indicating that clinical illness lasts longer before death than in other species. We don't know how bats get the disease except from other bats, but we do know that they pass it on to other species. Unprovoked attacks by rabid bats suggest that they have undergone mental changes.

SELLERS: The finding of infected bats in so many widely separated areas of this country seems to me to strongly indicate that rabies has been in our bats for a long time.

KOPROWSKI: To summarize our knowledge of bat rabies, then:

All bats are suspect, insectivorous as well as hematophagous.

Brain and salivary gland tissue of any bat which attacks a human being should be studied in a laboratory for the presence of rabies virus.

Colonel Burns' finding of rabies antibodies in blood pools of asymptomatic bats caught in enzootic areas, a finding which should be confirmed by other workers, suggests that bats may be a reservoir of the disease.

On Human Prophylaxis

KOPROWSKI: Now we have to return to the treatment of the children who were bitten in Simona. What should be done?

Since time is getting short, I would like to limit our remarks on human treatment to two items: first, the use of antiserum, and, second, preliminary results with chick embryo vaccine.

SELLERS: Georgia has been using rabies antiserum since 1948. We've given it to 60 or 70 individuals, limiting its use to those with severe bites on the face, neck, or hands, and to cases where the exposures were not more than 48 hours old. In all instances the antiserum was followed by appropriate courses of antirabies vaccine, and during this time there were no deaths among those receiving vaccine alone. We therefore have no convincing field evidence of the part played by antiserum in protection. The laboratory protocols, however, are very convincing, and I definitely endorse the use of antiserum in principle.

DEAN: Hyperimmune serum promises to be of value. Since the serum is of equine origin, however, it possesses the hazards inherent in products of this nature. We have observed two serious cases of serum sickness among 35 treated individuals.

FOX: At Tulane University, we have been trying the live Flury virus vaccine in prisoner volunteers to see if it can be used to replace current forms of the Pasteur treatment. The volunteers cooperating are inmates of the Mississippi and Louisiana State prisons. All of our work has been with high-passage virus, about 180th passage level, although 3 or 4 years previously Dr. Koprowski used the low-passage

virus, now used for dogs, in about 30 persons. In all, we have given one or more inoculations of this virus to about 170 or 180 persons, and one important fact is that we have observed no adverse effects.

The more important point, however, is that, although we know the Flury virus vaccine works well in dogs, we are still trying to find out if it does in man. A single injection of two dog doses does not induce development of detectable neutralizing antibody. However, it apparently has some effect because a second booster injection of equivalent size usually does produce antibody. Increasing the amount of virus inoculated by giving multiple doses often, and in proportions increasing with the amount, gives rise to antibody. Because of this we feel that the Flury virus probably does not multiply in man, at least when placed extraneurally.

The question arises at this point as to whether demonstrable antibody is essential to the protection of man. Without challenge experiments this cannot be answered. Our feeling is that appearance of antibody is our only possible index of success and that, before we can recommend Flury virus vaccine in place of currently accepted vaccines, we must find a way of using it that will result in as uniform an appearance of antibody as that following current forms of Pasteur treatment. Our goal, of course, is an effective vaccine free from the risk of neuro-paralytic accidents.

Currently, we are working with small intramuscular or intradermal inocula. Fairly good results have followed a schedule of 4 doses, 5 days apart. We are now trying more doses with a shorter interval. Because in giving the Pasteur treatment one is working against time, we

have set 15 days as the maximum length of a practical dose schedule, even though we have evidence that good results follow as few as 2 inoculations spaced 30 days or more apart. Also, since vaccine may have to be given together with hyperimmune serum, we are trying to determine whether the active response to vaccine is altered by the presence of passively acquired antibody.

DEAN: The use of the Flury strain in man is still in the experimental phase. It is important also that we emphasize presently approved methods of treatment. Thorough local treatment of wounds with 1 percent aqueous zephiran or 20-percent soap solution remains of paramount importance. Local treatment should be followed by a series of injections of brain tissue vaccine containing killed virus with or without the use of hyperimmune serum.

KOPROWSKI: I would like to tell you about the results of the use of antiserum in Iran last summer. In August, a rabid wolf (the virus was isolated from the animal's brain after its death) bit 27 people, of whom 17 received severe head and neck bites. Of the 5 persons who received Semple type vaccine alone, 3 died, while of the 12 persons receiving serum and vaccine, only 1 died. One child, who had a penetrating wound of the head and direct exposure of the brain to the saliva of the biting animal, survived—he was given 6 injections of serum at 2-day intervals, followed by vaccine.

Thus, we are leaving Simona and Neutralia and hope that when we return next year rabies will be eradicated. I should remind you, however, about the epigram of Jerrild concerning hope. "In all the wedding cake, hope is the sweetest of the plums."

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A Time Study Method for Public Health

By EDWARD M. COHART, M.D., and WILLIAM R. WILLARD, M.D.

THE Yale Public Health Personnel Research Project attempted to learn what health workers actually do on the job, in the belief that such knowledge might lead to recommendations for recruitment and training and for realignment of functions, and thus permit more efficient utilization of public health personnel. Time studies were considered essential in quantifying the descriptive information obtained through interviews and observation.

One hypothesis which the project attempted to test was that many highly trained professional and technical workers in public health are spending significant amounts of time in activities for which they have not been trained. Another hypothesis was that some of these activities should be shifted to other workers or the personnel performing them should be given specific training.

Public health work entails recruiting, budget preparation, personnel management, program planning, public relations, community organization, and supporting clerical and accounting work, in addition to technical activities. The Yale time study was constructed for the purpose of determining the allocation of the public

health worker's time to all these activities. To our knowledge, no proved instrument for this purpose existed.

In terms of time and effort, the development of time-study methodology proved to be a major portion of the project. By the time a satisfactory instrument was developed, it was impossible to complete a large-scale, definitive time study, but considerable data were secured and will be reported in separate articles.

Previous Time Studies

Reports of time studies in the public health literature are few. The most prevalent type of time study, and the simplest, allocates the time of public health workers to categorical programs (1-4). This approach is of value in determining whether program emphasis is properly related to the magnitude and importance of public health problems or to the funds that have been allocated for categorical purposes. Implications regarding the education and training of public health workers may be byproducts.

The technique of such studies is simple. The employee is asked to record his activities, usually to the nearest 5 minutes, and to code them in terms of program, such as tuberculosis, maternal and child health, and milk sanitation, according to a previously defined list.

Graning and his associates (5, 6) approached the problem of time studies from a point of view similar to that of the Yale project. They studied a large number of health officers and medical administrators in State and local health departments by questionnaire, in much the same manner as that described by Milne (4). Participants were asked to code each activity by program and by type of activity and to indicate whether, in their opinion, the activity required

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medical judgment. The activity code included many administrative items important to a consideration of adequacy of training and realignment of function, such as program planning, direction and supervision, records and reports, and budget and fiscal matters.

Two major criticisms can be made of the Graning study:

1. The data were gathered by means of a questionnaire, with little direct supervision to minimize differences of interpretation by the various participants.

2. There was no attempt to define "medical judgment." As a result, there is a wide spread in the way presumably similar activities are reported by various respondents as involving medical judgment. The authors defend their procedure by stating that the delegation of an activity by the health officer would depend in part upon whether or not he thought medical judgment was involved. By implication, the activities delegated by one health officer might not be delegated by another, depending upon each health officer's evaluation of the element of medical judgment.

There is some truth in this contention. What it ignores is the fact that any major change in training or realignment of function may require a new set of attitudes and concepts, and that education must precede such an effort, since frequently widely varying opinions can be brought closer together by an effective educational process. Therefore, any conclusion about medical judgment should be made according to clearly defined criteria, applied in a uniform way.

The National Organization for Public Health Nursing developed time-study techniques for the purpose of conducting cost studies. The techniques are similar to those in other studies except for the classification of activities (7). The activities are divided into components (preparation, postactivity, and conferences relative to the activity), "cost center" programs (home visits, clinic activities, or school programs, for example), and services (such as antepartum and acute communicable disease). This study has important administrative implications, and its techniques are applicable beyond the public health nursing field. However, it does not provide the kind of information essen-

tial to a consideration of efficient functional utilization of personnel.

It was thought that industry might have developed techniques relative to time studies of administrative personnel. A review of industrial management literature and conferences with several industrial personnel managers revealed that industry had no relevant experience to contribute to this problem. Industrial time studies have been primarily of the time and motion variety and therefore applicable to manual operation but not to administrative and executive work (8). Only recently has the study of administrators and executives been explored.

Basic Principles and Procedures

There are a number of principles and procedures that are prerequisite to an accurate and effective time study.

The objective of the time study must be clearly identified and the instrument must be constructed with a singleness of purpose. A time study that attempts to get many types of information will usually get none. Time studies designed to allocate time to categorical programs can be relatively simple; those aimed at allocating costs or defining types of functional activity will have to be more complex.

Terms and procedures must be carefully defined and clearly understood by the participants. Not only must instructions and definitions be written clearly, but they must also be discussed with the participants. Even for the simplest of studies, an initial trial run will eliminate many difficulties and facilitate a successful study. After the trial period, it should be possible to delegate the responsibility for the collection and initial checking of reports to a member of the agency's staff.

The length and spacing of the time periods covered by the study should give a representative sample of the year. The recommended pattern is a period of a week 3 or 4 times during the year, or a day or two each month of the year. It is advisable to stagger the weeks of the month and the days of the week. If the time-study data are divided into halves and the results of the two halves are similar, one can assume that a sufficient interval was used to get consistent results. By repeating comparisons, using

smaller segments of time, the minimal period can be determined.

Time must be accurately recorded. In most time studies, the starting time and the total time for each activity are recorded in appropriate columns. Although this technique is satisfactory, the Yale project found that a time bar was simpler for participants to use and worked just as effectively.

Participants must code their own activities. Theoretically, it would be better for participants to record their activities in narrative form and for the research staff to code the activities. In practice, however, it proved impossible in the Yale project to secure narrative time logs from most public health workers in sufficient detail to permit adequate analysis.

The system of classification must be simple.

If the workers are expected to classify and code their own activities, the categories must be relatively few in number and so clearly defined that, after proper instruction and a trial run, the workers can classify their activities with ease and without appreciable error. Further analysis of any one category of activities can be made by the research staff, if detailed activity inventories of the workers are obtained simultaneously through interviews, and if the activity inventory classification is related to the time-study classification. Ultimately, such analyses were possible in the Yale project.

Initial Developmental Efforts

Answers to two questions were fundamental to the conduct of the time study. What infor-

List of Activity Categories

1. Other Agencies. (Not joint program planning, which is No. 9.) Organizing and participating in the planning of relationships with, and securing support for program from, other agencies and officials. Examples: hospitals, voluntary agencies, boards of education, mayor, legislature, civil service, finance department, welfare agencies, health departments at same level.

2. Other Health Departments. (Not at same level, which is No. 1.) Organizing and participating in the planning of relationships and consulting with health departments at different governmental levels. Examples: planning for financial support, exchange of services or personnel, joint programs.

3. Giving Professional Education. (Not inservice, which is No. 17 and No. 18.) Planning, organizing, participating in the giving of professional education. Examples: preparing, organizing and conducting workshops, formal classes in colleges and professional schools, lectures at professional societies.

4. Group Organization. Planning for, organizing, and training specific purpose groups. Examples: X-ray survey committees, fact-finding groups, study groups, volunteers in clinics.

5. Talks to Public. Planning, preparing, and delivering talks to public. Examples: mothers' classes, high schools, service clubs, PTA's, food handlers.

6. Planning Mass Media. (Not its preparation, which is No. 10.) Planning content and employment of mass media of communication. Examples:

audiovisual aids, pamphlets, newspaper publicity, radio scripts.

7. Information Service. (Not as part of case visit, which is No. 10.) Answering individual requests for information and escorting visitors through the health department.

8. Health Department Program Planning. Within the health department, planning research into health needs and planning the initiation, revision, scope, methods of execution, operating policy, and evaluation of health programs.

9. Joint Program Planning. Working with other agencies to plan research into health needs and to plan the initiation, revision, scope, methods of execution, operating policy, and the evaluation of health programs.

10. "Technical." (Not arithmetic computations, posting, adding and transcribing reports, distributing mass media, which are No. 11.) Primary medical, professional, technical activities such as:

Examination and treatment of patients, home visits, environmental sanitation visits, advice to clients and patients, taking medical and social histories, epidemiological investigations.

Laboratory and other test procedures, reading X-rays, preparation of mass media, planning and editing the annual report, preparing budgets and diets, statistical analysis.

11. "Ancillary." (Not giving information to clients, which is No. 7.) Essential supporting activities, such as:

mation was the time study to elicit? How was the desired information to be obtained?

The initial plan was to match with time allocations the detailed activity information obtained from interviews and observation. The time information was to be obtained from time logs kept by participants in their own words.

Toward the end of 1950, the first formulation of time-study content and method was completed. A time-log form was designed to determine what activities a public health worker performs, how the worker performs them, and the approximate time involved. It consisted of three columns: a narrow left-hand column in which fixed time intervals were specified and two broad columns, one headed "What: Job Duty or Activity," and the other, "How: Means Employed." Instructions for the use of the log

suggested simply that each activity be recorded in terms of what, how, and how long. A partial list of activities and the way in which these activities might be performed was furnished as a guide. The list named about 60 possible activities, such as investigation, survey, clinic examination, sample collection, and school visit, and about 50 areas in which these activities could be performed, such as tuberculosis, civilian defense, epidemiology, and venereal disease. Coding and analysis of the completed time logs were to be performed by the research staff in accordance with the basic activity codes developed for the interview part of the project.

A pilot run of this time study, including careful orientation of the participants, was undertaken in one local health department. The inadequacies of this approach were soon appar-

List of Activity Categories—Continued

Preparation for clinic and obtaining identifying information (name, address, etc.) from clients. All record and report keeping, compilation of reports, designing and filling out of forms (includes daily time log), car servicing.

Glassware preparation, media making, issuing of biologicals, taking and developing X-rays.

Issuing supplies, distributing mass media, filing, taking dictation, mimeographing, opening and distributing and sending out mail, transferring and placing telephone calls, making appointments.

12. Financial Management. (Not activities with other agencies or officials, which are No. 1, and not processing purchase orders, keeping accounts, preparing financial statements, performing computations, which are No. 11.) Planning, preparing, justifying, and controlling the budget. Examples: planning initial purchases with vendors, planning cost studies, discussing budget plans, authorizing purchases or adjustments between accounts, allotting funds, reviewing financial statements.

13. General Services Management. Planning and controlling organization "housekeeping" activities. Examples: planning and controlling report, record, and filing systems; space usage, construction and installations; custodial and grounds services; building and equipment repair.

14. Personnel Management. (Not supervising personnel, which is No. 15.) Recruiting, selecting, transferring, counseling personnel; and authorizing vacation, leave, and travel. Examples: interviewing candidates, preparing qualification standards,

reviewing credentials, recommending or giving disciplinary action, counseling re personal problems or vocational guidance, writing letters of recommendation.

15. Personnel Supervision. (Not training, which is No. 17.) Giving immediate personal direction to a staff member. Examples: giving assignments, review through observation, discussions, analysis of records or reports.

16. Receiving Supervision. Receiving the services described in No. 14 or the supervision described in No. 15.

17. Individual Inservice Training. Planning, organizing, and giving inservice training and education for individuals. Examples: conferences, close collaboration, field trips, provision of study outside the department.

18. Group Inservice Training. Planning, organizing, and giving inservice training and education for groups of workers. Examples: lectures, staff meetings, field trips.

19. Own Education and Training. Attending professional meetings, classes, workshops, staff meetings; reading professional literature; field orientation; receiving inservice training.

20. Social Activities. Achieving and maintaining rapport with co-workers, "passing the time of day," social conversations, arranging for office parties.

21. Personal. Meals, coffee hours, rest periods, sick leave, dentist and doctor appointments.

ent. The participants found it extremely difficult to relate their activities to the fixed time intervals on the log and to identify the what and the how of the activities in a few short words or phrases. In addition, the participants attempted to fit their own activities into the suggested list, with resulting distortion and inaccuracy in their reporting.

In an attempt to remedy these faults, the time study was revised early in 1951 in the direction of a more nondirective instrument. The time-log form and the instructions were modified to give the recorders more freedom, and codes were developed especially for the time study. Coding and analysis were still to be done by the research staff. This edition of the study was administered to the personnel of health departments in Michigan, and the returns revealed that the information was adequate only for an analysis of time distribution by program. It was not possible to classify the activities according to the nature of the activity or the persons or organizations with whom the activity was performed, as had been planned. (The method and findings of this portion of the study are reported in a separate article, which appears on p. 577 of this issue.)

Since the primary objectives of the time study had not yet been accomplished, further explorations into content and method were undertaken. One of these was an attempt to develop a code based on classification of public health activities according to level of difficulty. Five levels were established, and an effort was made to allocate the hundreds of individual activity items to these levels. Difficulties were soon encountered. Agreement as to the proper level of difficulty for some of the activity items could not be reached. The number of items which had to be included if coding was to be uniform was tremendous. The most important factor in the decision to abandon this approach, however, was the growing realization that it would probably prove impossible to obtain narrative time records in sufficient detail for accurate classification.

At this stage of the study, it became evident that two major difficulties were blocking its effective execution. One was the emphasis on the differences among the several types of public

health personnel, with the resultant development of a different, very detailed code for each type. The other was the impossibility of obtaining narrative reports of sufficient clarity and in sufficient detail to permit classification into the hundreds of activity code items.

The Final Method

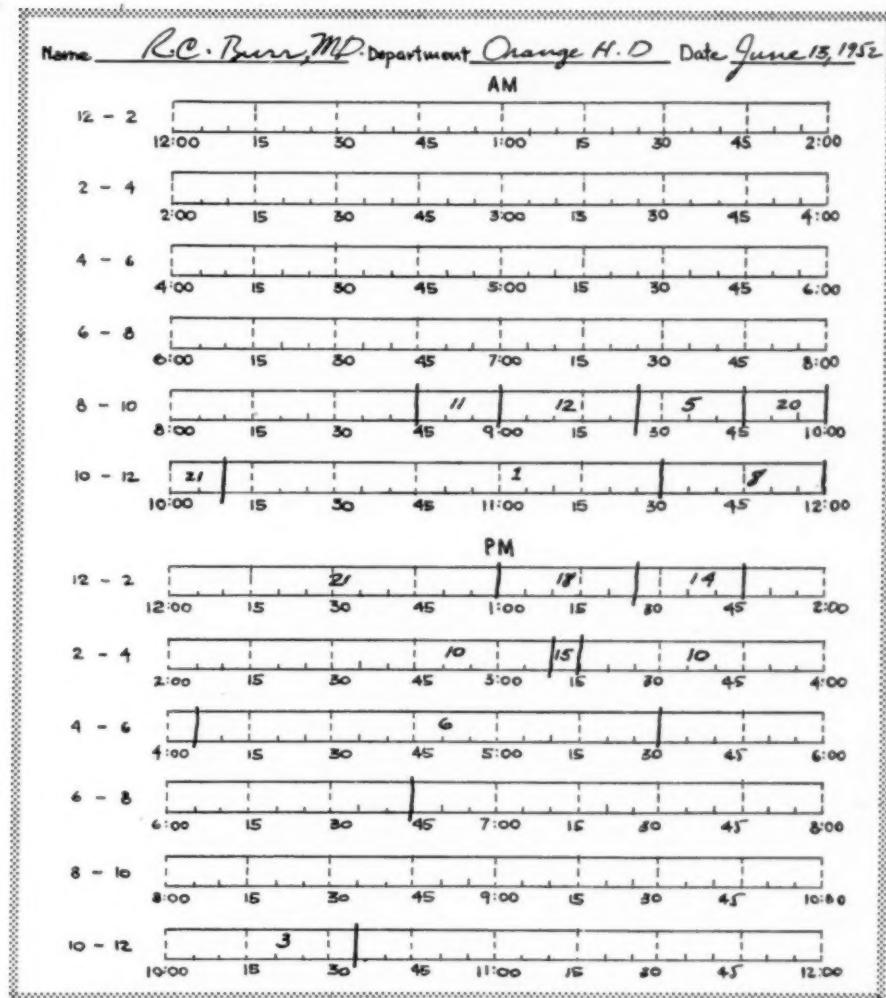
From this experience, the project staff concluded that the narrative time study was not feasible in research of this kind, and that the investigation should be founded on the broad similarities of activity among the several kinds of public health workers. This decision required that the number of categories for classification of activities be relatively small and that the categories be clearly defined. It was felt also that the time study should give promise of yielding new knowledge. Toward these ends, an entirely different instrument was developed.

The new instrument was designed to reveal the distribution of time in accordance with a broad, functional classification of activities which cut across both programs and services. It contained 21 activity categories applicable to all public health personnel (p. 572). For purposes of analysis these categories were grouped into four major classes of activity: technical, category 10; ancillary, category 11; administration, categories 8 and 12 through 19; and community relations and organization, categories 1 through 7, and 9.

Participants were to code their activities according to the list of 21 categories and to enter the code number on a daily time log. The time log is actually a time bar, or time scale, in which time segments are delineated by drawing two vertical lines (see p. 575). The activity list, a sample time log and illustration of its use, and simple directions for recording the time data were included in an instruction booklet, which was given to each participant.

Following a pretest in a local health department, in which difficulties encountered were remedied, the time study was administered to personnel in the State health department and selected county health departments in Maryland during the fall and winter of 1952-53. The participants were asked to keep the time study daily for 2 days each month for 5 months.

Sample Daily Time Log and Illustration of Its Use



The following activities have been placed on the time log above:

8:45- 9:00	Sorting the mail, straightening desk, signing letters secretary typed previous afternoon (11).	12:00- 1:00	Lunch (21).
9:00- 9:25	Phone calls to manufacturers' representatives to decide type of refrigerator to purchase for lab (12).	1:00- 1:25	Holding educational staff conference to report on new drug (18).
9:25- 9:45	Letter to president of PTA about talk she wants given at organization's next meeting (5).	1:25- 1:45	Interviewing candidate for staff nurse position (14).
9:45-10:00	Visiting various sections of department (20).	1:45- 3:10	Travel to Lincoln School and filling in for physician at well child conference (10).
10:00-10:10	Coffee (21).	3:10- 3:15	Phone call from staff sanitarian seeking advice on closing restaurant (15).
10:10-11:30	Travel to mayor's office, meeting with him to discuss getting several agencies together to plan for medical defense service, return to office (1).	3:15- 4:05	Continuing well child conference and return to office (10).
11:30-12:00	Meeting with division heads to plan civil defense program (8).	4:05- 5:30	Outlining TB pamphlet with health educator (6). Then left for home.
		6:45-10:35	Travel to and attending medical society meeting to give talk on school health program, travel home (3).

The days were assigned so that each part of the month and each part of the week were represented.

The time study was administered in the following manner. One or two days prior to the scheduled beginning of the first 2-day period, two of the project's staff workers, who were interviewing members of the department, held a time-study orientation session with all selected participants. These sessions lasted approximately an hour and consisted of a presentation and explanation of the time-study code, a review of samples of completed time logs, and a "dry run" in which the participants coded and recorded activities for a typical day. Discussion and questions were encouraged. Then, on the first day of the time study a member of the research staff visited each participant in order to check on procedure and to answer any questions which might have arisen.

Secretaries of health department units were made responsible for the mechanics of administering the time study after the first month. They distributed the daily time logs, collected them after they had been completed, and forwarded them to the project headquarters. This procedure helped to keep the information confidential.

The cooperation of the participants was gratifying. More than 85 percent of the people who were asked to execute the final time-study instrument did so until completion of the study.

The time-log data were transferred to punch cards by the clerical staff of the research project and then machine tabulated. The research staff made analyses, for the State and the local health departments separately, of the average daily working time, of the proportion of time spent in the several major categories of activity, and of the relative number of individuals participating in these activities by service and by administrative level. In addition, the relationships between type of activity and level of education, public health training, and salary (as revealed in the interviews) were studied.

Conclusions

After a number of false starts, a method for a time study of public health personnel was developed. Experience with this method in one

State and in several local health departments indicates that the coding concepts involved are, with minor exceptions, sufficiently clear-cut to enable participants to keep accurate daily time logs with a minimum of effort and that, as a consequence, the time study can be easily and successfully administered. It was found, furthermore, that the accumulated time-log data lent themselves to expeditious analysis and yielded knowledge not heretofore available.

The present time study differs from previous similar studies of public health personnel in two important respects. The daily time log is a time scale, or time bar, which simplifies the mechanics of recording. The system of classification employed is built upon broad, functional categories of activity which are not limited to either specific programs or specific services.

It is believed that this time-study method can serve as an important instrument in public health research. When used in conjunction with well-planned interviews, possibly supplemented by spot observations, the time study can produce quantitative information fundamental to progress in public health administration.

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Program Distribution of Working Time in Health Departments

By EDWARD M. COHART, M.D., and WILLIAM R. WILLARD, M.D.

EARLY in the Yale Public Health Personnel Research Project, a time study was conducted in the State health department and in eight selected local health departments in Michigan. The study was intended to determine the distribution of time according to (a) programs, (b) professional and administrative activities, and (c) persons with whom activities were carried on. The method used did not fulfill all these objectives, but it was possible to analyze the data for program distribution of time, in a fashion similar to that used by Milne and his co-workers in Mississippi (1). Moreover, the experience in Michigan contributed to the development of another time study method, as reported in a separate article (this issue of *Public Health Reports*, p. 570).

The Study Method

The time log used for this study was a simple instrument. It consisted of six blank columns: a narrow left-hand column headed "When: Time Started," a broad center column headed

"What, With Whom, and How," and four narrow right-hand columns headed "Travel," "Reports and Records," "Correspondence," and "Telephone." Instruction sheets included several sample time logs and suggestions for keeping the record. Each activity was to be reported by recording its starting time, its general nature in a one- or two-word summary, what was done, its purpose, how it was done, and with whom it was done. Time spent in travel, in reading and writing reports and records, in correspondence, and in telephone conversations for each activity was to be entered in the appropriate right-hand column. Activities were to be recorded to the nearest 5 minutes.

All full-time professional and semiprofessional personnel with the exception of secretarial and clerical workers performing routine tasks only and the staff of the State biological laboratory were eligible to participate in the study. When a number of workers in the same professional category in the same health department were performing essentially the same activities—school nurses with almost identical assignments, for example—only one of these workers was asked to keep a time record. The time allocations of this worker were then multiplied by the number of workers in the group.

Of 185 eligible workers in the State health department, 108 (58 percent) participated either directly or through a representative. This relatively low percentage resulted from the fact that only 29 percent of the laboratory personnel participated, as compared with 80 percent or more of the personnel in the other

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services. With one exception, the laboratory participants were all workers in branch laboratories, the central laboratory having declined to participate in the study.

Of 181 eligible workers in the eight local health departments, 166 (92 percent) participated either directly or through a representative. The percentage of participating personnel in all services except the medical service was high, and even in the medical service 57 percent participated.

Thus, the eight local health departments are adequately represented in the sample, but the State health department sample is definitely biased by the exclusion of a major portion of the laboratory service.

The participants were asked to keep the time log daily for one week during the fall and winter months of 1951-52. It was felt that one week would be sufficient length of time to test the method used, which was the primary purpose of the study in Michigan. Recently, Milne and his associates (1) have reported, on the basis of a time study in Mississippi, that a reasonably accurate estimate of the distribution of time can be obtained from a 1-week sample, provided that an unusual week, such as one during the summer months, is not chosen.

Approximately one-third of the time of both State and local health department personnel could not be identified with a program, a proportion somewhat greater than the 29 percent of "interrelated time" found in the Mississippi study. It is believed that a truly discriminating instrument would yield a smaller residue of time which would defy program identification. The time log used in this study would appear to be less efficient than the daily time sheet with checklist used in the Mississippi study.

The time not identified with any specific program was allocated to specific programs according to the distribution of program-specified time. This was done for each service in the State and local health departments separately. The results are, therefore, comparable with the results that Milne reported for Mississippi on the basis of the distribution of "interrelated time according to the percentage distribution of total identified time." It is recognized that the validity of this procedure for allocating uncategorized time can be questioned, especially when it involves such a sizable proportion of the total time. However, in the absence of more accurate data, this would appear to be the only practical expedient. The results are shown in tables 1 and 2.

Table 1. Percentage of total working time devoted to specified program areas in the Michigan Department of Health¹

Program areas	Medical service	Nursing service	Sanitation service	Statistics service	Laboratory service	Administration service	Other services	All services
Number in service	10	13	27	8	90	16	21	185
Number participating in study	8	11	22	8	26	14	19	108
Acute communicable disease	2.9	2.3	0	52.7	19.3	1.7	2.8	12.4
Cancer	1.0	0	0	3.0	5.5	.1	.1	2.9
Chronic disease	17.8	.2	0	0	.2	.2	1.4	1.2
Civil defense	2.8	0	0	20.5	0	1.7	1.6	1.4
Crippled children	.3	0	0	0	0	0	.3	.1
Dental hygiene	20.2	11.6	.1	.8	0	0	25.4	4.8
Environmental sanitation	1.0	0	35.1	0	3.1	35.4	2.9	10.1
Heart	.3	0	0	0	0	0	.2	.1
Industrial hygiene	.2	8.2	63.9	0	19.0	25.1	.3	21.4
Maternal and child health	32.0	.1	0	17.7	.9	4.8	48.9	8.9
Mental hygiene	.3	6.7	0	0	0	0	.8	.6
School health	3.9	6.2	.7	0	0	1.8	11.5	2.2
Tuberculosis	17.3	18.5	.2	5.3	17.3	19.6	2.6	12.9
Venereal disease	.1	46.2	0	0	34.7	9.6	.2	21.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹ Estimate on basis of the allocation of uncategorized time to program areas according to distribution of program-specified time.

Table 2. Percentage of total working time devoted to specified program areas in eight local health departments in Michigan¹

Program areas	Medical service	Nursing service	Sanitation service	Laboratory service	Administration service	Other services	All services
Number in service-----	14	104	31	7	17	8	181
Number participating in study-----	8	102	29	7	14	6	166
Acute communicable disease-----	15.5	11.8	1.3	12.6	15.9	0.6	10.2
Cancer-----	0	0	0	0	0	.9	0
Chronic disease-----	.4	1.2	0	.1	0	0	.7
Civil defense-----	.7	.5	.3	0	0	0	.4
Crippled children-----	.5	4.9	0	0	1.2	3.2	3.1
Dental hygiene-----	1.6	1.5	0	0	.2	20.2	1.9
Environmental sanitation-----	5.0	0	91.9	48.9	33.5	29.4	22.5
Heart-----	0	.3	0	0	0	0	.2
Industrial hygiene-----	0	0	0	.1	.4	0	.1
Maternal and child health-----	37.4	19.0	0	1.8	19.0	3.5	15.8
Mental hygiene-----	1.8	2.3	0	.1	0	26.6	2.6
School health-----	12.8	42.6	6.5	0	1.8	15.5	27.4
Tuberculosis-----	21.0	15.3	0	10.2	22.3	0	12.9
Venereal disease-----	3.3	.6	0	26.2	5.8	.2	2.2
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹ Estimate on basis of the allocation of uncategorized time to program areas according to distribution of program-specified time.

Allocation of Time to Programs

In the State health department, 21 percent of the time is devoted to industrial hygiene, and a similar proportion of the time to venereal disease control. Ten to fifteen percent is spent in each of the following programs: environmental sanitation, acute communicable disease control, tuberculosis control, and maternal and child health, including school health. Dental hygiene and the chronic diseases, including cancer and heart disease, each accounts for 5 percent of the time. One percent of the time is devoted to mental hygiene, and 1 percent to civil defense.

In the local health departments, the greatest emphasis is on health programs for children. Thus, 27 percent of the time is devoted to school health; 16 percent to maternal and child health; and 3 percent to crippled children. Furthermore, it can be assumed that children are the major recipients of services in the programs for acute communicable disease control and for dental and mental hygiene. Ten percent of the time of personnel in local health departments is devoted to the former, and 2 percent to each of the latter programs. Environmental sanitation absorbs 22 percent of

the time. There is practically no industrial hygiene activity on the local level. About 13 percent of the time is devoted to tuberculosis control, and 2 percent to venereal disease control. Chronic diseases, including heart disease and cancer, account for 1 percent of the time.

Discussion

The authors do not possess the intimate knowledge of the situation in Michigan that would be necessary to evaluate the distribution of time shown by this study. Nevertheless, there appear to be a number of findings that call for investigation. It would seem, for example, that insufficient attention is being given to mental health and to the noninfectious diseases and disabilities of adult life.

The emphasis placed on any health department program is determined by such factors as the nature and magnitude of the problem, the knowledge and ability to do something about it, the need for organized social action for control, the interests and desires of individuals in authority and pressure groups, the availability of funds, and the dictates of tradition. It can be accepted as axiomatic that

all institutions, good and bad, manifest a lag in meeting the problems for which they are responsible. In this respect, the difference between good and bad is one of degree only. The question thus becomes, "How far behind are we?"

An efficient health department must repeatedly reexamine and reevaluate its program in terms of total community needs and total community facilities. Even in the absence of concrete evidence, it can be assumed that there is room for improvement in any program. One way to measure what is being done in health departments is by the time-study method. The time study, however, gives only an incomplete picture, at best. It must be supplemented by much qualitative information about the program and complemented by a knowledge of the community and its health needs.

Summary

As part of the Yale Public Health Personnel Research Study, a time study was conducted in the State health department and eight local health departments in Michigan. The data obtained from time logs kept daily for one week could be analyzed only for program distribution of time. It was found that major emphasis was on such programs as environmental sanitation and maternal and child health, orthodox programs hallowed by tradition.

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Child Health Standards for Paints

Standards to minimize hazards to children from residual surface coating materials were approved February 16, 1955, by the American Standards Association.

The specifications cover liquid coatings, such as paint, enamel, and lacquer, that are to be used to paint children's toys or furniture or the interior surfaces of homes. They are intended to reduce the danger of poisoning that may occur if this coating is chewed off and swallowed by children.

The standards specify that paint and other coatings should not contain lead compounds with a lead content in excess of 1 percent of the total weight of the solids, including pigments and drier. The coatings should not contain compounds of antimony, arsenic, cadmium, mercury, selenium, or barium (when soluble by stirring for 10 minutes with 5 percent hydrochloric acid at room temperature) introduced as such in the formulation of such coatings.

Coatings complying with this standard may be marked: "Conforms to American Standard Z66.1-1955, for use on surfaces which might be chewed by children."

The standards were developed by the Sectional Committee on Hazards to Children, organized by the American Standards Association under the sponsorship of the American Academy of Pediatrics.

European Approaches to Aging

By WILMA DONAHUE, Ph.D., and CLARK TIBBITS

AMERICAN PARTICIPANTS in the Third International Gerontological Congress in London who took advantage of the opportunity to observe programs for older people in the United Kingdom and in nearby countries came home inspired by the extent and variety of activity they found (1).

The appearance of large proportions of older people in the populations of European countries occurred about a generation earlier than in the United States. Hence, it is natural that these countries should have done a good deal of pioneering in meeting their needs. This brief report presents the highlights of activity in the countries with the most advanced approaches.

Financing the Later Years

Most European countries have federally operated contributory, work-connected pension

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systems similar to our Old-Age and Survivors Insurance, with supplementation through assistance grants. Eligibility is usually based on retirement from gainful employment or survivorship. Pensionable age for men varies from 65 years in Denmark, England, and Switzerland to 67 in Sweden and 70 in Norway.

Cash benefits are normally insufficient to meet all requirements, particularly those of persons with problems of infirmity, illness, living arrangements, or social isolation. Recognizing this circumstance, most countries offer many services and facilities on a community support basis, subsidized by either public or voluntary funds.

Medical Care

All European countries have infirm, long-term ill, and invalided older people who present an increasing demand for health services and custodial care. The United Kingdom, Norway, and Sweden are undertaking to meet medical needs through universal coverage schemes which guarantee the availability of the best the countries can afford. Denmark and Switzerland have health insurance schemes, compulsory for individuals in certain income brackets and administered by local societies, usually under the supervision of state authorities.

Most of the hospitals are community operated and many include special geriatric units. Frequently, especially in the Scandinavian countries, the chronic hospital or geriatric unit is a part of a total housing plan for old people. A special geriatric ward is to be found in Stockholm's Municipal Hospital.

Hospitals for the mentally ill are mainly

state-operated but are crowded and generally considered understaffed and inadequate in number. Some efforts are being made to make more effective use of present space since there is little construction in this field. In England patients who have become old in mental hospitals, but who no longer need special psychiatric care, are being released to live in special homes for the confused senile. Results thus far indicate that many such old people improve in the homelike, nonrestrictive atmosphere. In Amsterdam, plans are under way for a "transition hospital" for confused patients where treatment for physical and mental disorders will be carried out with the expectation that a significant proportion of the patients will be able to return to their homes instead of being committed. Cities in most countries have begun to establish outpatient health department services for the mentally ill.

Perhaps the most striking feature of medical programs is the emphasis placed on rehabilitation. Most hospitals have extensive facilities for thermal and mechanical therapy. Dictated in part by construction and operating costs, the underlying objective is to enable older people to remain functional and at least partially self-sufficient in their own homes. Accordingly, in addition to the hospital services, such aids as spectacles, hearing aids, dentures, occupational therapy, and chiropody are widely available in Great Britain, Scandinavia, and, to some extent, in Holland and Switzerland.

Home Services

Remaining in one's own home becomes possible for many old people because suitable housing and community services are becoming available. The principle of home living is rooted in several factors: the conviction that most want the dignity and the security it affords; the knowledge that people generally recover more rapidly at home; the costliness of hospital and domiciliary facilities.

Many infirm elderly people are enabled to remain at home, alone or with children, through the close integration of hospital and home medical services, visiting nurse, housekeeping help, night attendants, laundry and bath services, friendly visitors, community kitchens to which

older people may go for meals and from which meals are taken to elderly shut-ins. Even in France, where relatively little has been done for older people, these special home helps are available for a limited number of older people through money raised by the National Old People's Day. In Scandinavia, where home helps are being developed on both a paid and a voluntary basis, many people of the middle class are volunteering to go into the homes of older people needing domestic or other services and are ready to accept training for that work.

Community clubs for older people are becoming popular in England, Holland, and Switzerland but not in the Scandinavian countries, Germany, Italy, and France. In some communities vacations are provided, thus taking the old person out of his children's home for a few weeks a year.

Day hospital programs where old people receive treatment and take part in occupational therapy are common in the geriatric hospitals of England. Hostels and halfway houses relieve hospitals of patients who are mending but not yet ready to go home.

Many of these services are coordinated by the district medical officer of health. In the borough of Finsbury, London, the health officer has added an SOS card system. Older people living alone summon help by placing the card in the window. Neighbors notify the health department when such a card appears.

Housing and Living Arrangements

Both independent and group housing for pensioners have been developed in Europe in great variety. The Swedish Government makes it incumbent upon every community to provide housing for its elderly people. Government subsidies are generally available in most countries though, in some cases, communities have built such dwellings on their own initiative.

In all these countries there has been a good deal of experimentation ranging from single detached dwellings to large organized villages containing acute and chronic hospitals, communal dwellings for the frail, and individual modern apartments for the able-bodied. From many experiments a number of useful principles have emerged.

One of these is that the greatest possible degree of privacy should be afforded, preferably in one's own flat or apartment, or, at least, in a private room in a boarding or old age home. Some that have provided dormitory living are now being remodeled to afford individual rooms and apartments.

The second principle is that housing must be located in the city in proximity to friends and institutions and not in remote, rural locations. Most of the countries of northwest Europe are building housing to replace that knocked out during the war. Scattered through these developments, in single units or in blocks, are a good many flats, modern apartment buildings, and row houses built especially for older people.

The third principle, now taking hold, is that housing and medical facilities should be separated. Incorporation of a hospital into a housing development suggests illness, it is believed, and tends to make for expensive multiplication of facilities. Accordingly, new housing facilities are being built as housing, and attention is given to facilitating transfer to medical and custodial institutions if the need arises.

Institutional homes for the aged date back many years in Europe. Many of them are still in use and are heavily endowed by voluntary societies. While the newer homes are generally public facilities, there are still many being built by religious organizations and labor groups, especially in Holland and Germany.

One aspect of housing that strikes the observer is that adult children are expected to provide homes for their aged parents if at all possible. In Great Britain, almoners attached to hospitals and welfare agencies make great effort to achieve this arrangement. In Germany, Switzerland, Italy, and France it is a matter of expectation that the family will care for its older members. There is less emphasis in the Scandinavian countries upon keeping the old person at home, and attempts are made to place the older person under circumstances best for all ages concerned. In Denmark, adult children are legally liable for the support of their parents. Until recently, the pension program accommodated such economic pressure, but present difficulties have increased the need of the aged to depend on their children, with resulting friction and resentment on the part of

both generations. But in all countries, the home helps mentioned earlier have been developed, in part, to ease the burden on families trying to accommodate aged parents.

Activity Programs

The prevailing attitude in most European countries has been that older persons are worn out and eager to rest. Relatively little effort has been made to find new roles for retired people or opportunity for creative or recreational pursuits in housing projects or in old age homes.

Yet, there are some outstanding exceptions. One is the Finsbury employment scheme for the elderly, sponsored by the health department, in which older men and women of the community work 2 hours a day testing fountain pens, assembling electric switches, packaging bandages, and on other light work. Beyond the experimental stage, the workshop is now housed in its own modern building where it affords social contacts and income supplement to its workers.

Employment

Primarily to hold down pension costs but also to overcome worker shortages in some occupations, attention is being given to continued employment of older people. Pension systems contain financial incentives to remain at work. In Great Britain, a national commission is trying to correct the factors which make for inadequate utilization of older people's services. Employers are being urged to examine their practices to see whether more older workers can be engaged and retained.

Scandinavian countries have developed practically no recreational activities for older people. Currently, these countries are giving attention to the question of whether gainful employment should be further extended beyond age 65 and to the question of training for arts-crafts in which there is already a rich background.

Organization

Public agencies and funds are involved in programs for older people to a much greater extent than in the United States. The prin-

pal reasons probably lie in the actual and relative magnitude of the older population and in the shortage of private funds resulting from the costs of war. There is, however, every evidence of willingness on the part of voluntary groups to contribute funds and personal services to the limit of their capacities.

Striking and unique is the close working relationship between statutory and voluntary agencies. England alone, for example, has more than 1,100 local committees on aging with private and public organizations equally represented. Some of the home services are provided by public bodies, such as health, welfare, and housing agencies; others by voluntary groups such as the tuberculosis society, Red Cross, Women's Voluntary Service. In some instances public agencies supply funds or materials and voluntary groups the personal services.

Many home services are performed by paid or volunteer workers who are, themselves, in the middle or older ages. Finland, Sweden, and Great Britain have developed training programs for women seeking positions as matrons of homes, domestic helpers, and so forth. Swedish training programs are government sponsored. The trainees are employed in homes for the aged which are operated by the local government in cooperation with the federal government.

Medical schools are giving some attention to the practice of geriatrics, and younger physicians are being urged to study the needs of older people. There is growing opinion among medical people for special departments of geriatrics in the medical schools and training hospitals.

Research

Research on aging is going on in all countries. In some places, as in Italy, it appears to be the principal activity. And most of it is directed toward biological and medical problems. Most of the gerontological societies, such as the new one in Switzerland, are composed of medical people and researchers.

There are exceptions, however. England is working on psychological problems and work performance. The monumental works of Rowntree (2) and Sheldon (3) on health and social circumstances of older persons are being followed by intensive community studies.

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The habits and interrelationships of rodent species in the Hamakua District of Hawaii are found to be favorable to the perpetuation of enzootic plague.

Observations on Rats in an Enzootic Plague Region of Hawaii

LEO KARTMAN, Sc.D., and RICHARD P. LONERGAN, M.P.H.

THE INTERRELATIONS of different rodent species, their survival, movements, feeding habits and, in general, their ability to coexist are fundamental conditions for the maintenance and spread of wild rodent plague. Expert opinion considers that infection per saltum is operative under unusual circumstances, whereas the spread of the disease is primarily by contiguity, probably by "an accumulation of small movements among rodents" (1) and by normal dispersal (2-4). In a discussion of this problem, Davis (5) distinguished between intricolonial and intercolonial spread of plague among South African rodents and concluded that spread by the former method was more usual.

The extent of movement and the home range of small mammals generally has been found to be quite restricted (6-9) and the movement rate

of *Rattus norvegicus* is known to be very low in constant environments (10). Similarly, a study of rats in Hawaii indicated both limited movements and a restricted home range on the island of Oahu (11).

A project on methods for the control of fleas on wild rodents inhabiting an enzootic plague region on the island of Hawaii provided observations pertinent to a discussion of the relation of rat characteristics to the perpetuation of wild rodent plague.

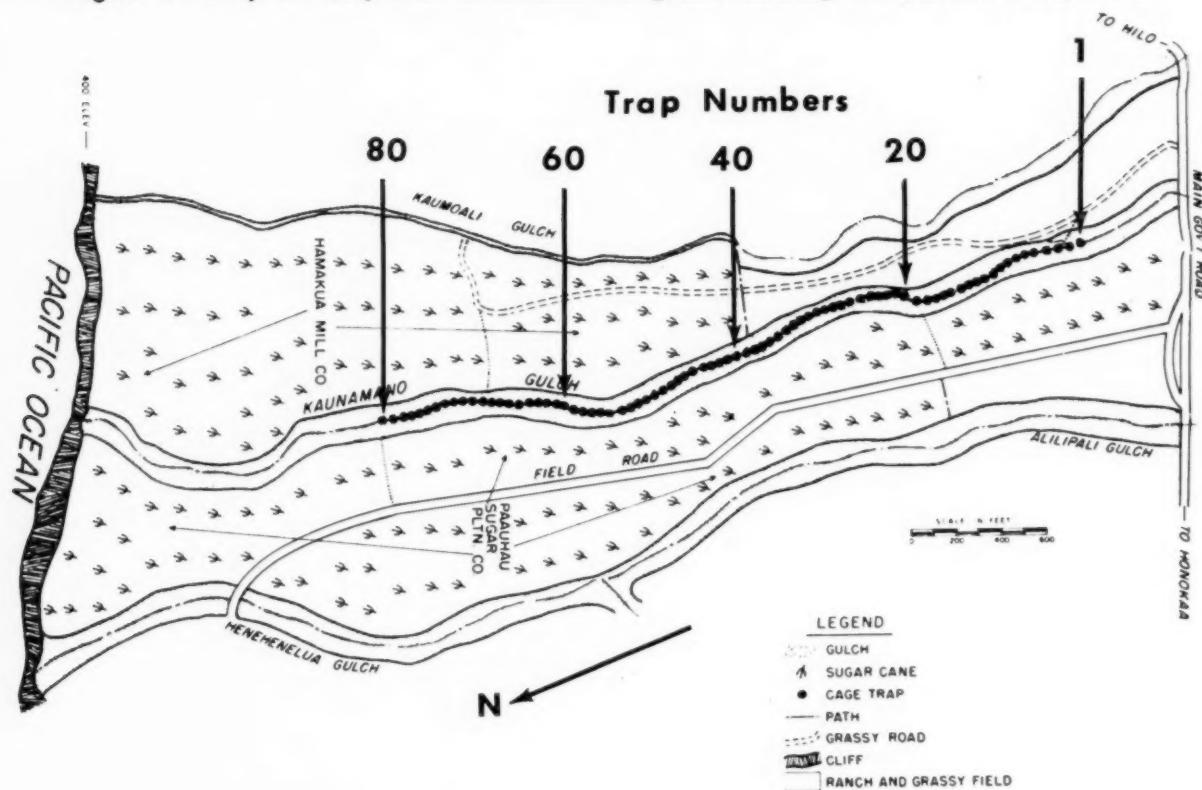
Study Areas and Methods

A detailed description of the study areas and materials and methods employed already has been presented (12). The work, which was concerned primarily with wild rodent flea control, was conducted from February 1952 to May 1953 in a field of sugarcane and in a gulch near the town of Honokaa, Hamakua District, Hawaii. Plague is both enzootic and endemic in this region.

Most of the work was done in Kaunamano gulch, one of numerous ravines bordered by sugarcane fields, grassy slopes, and small cultivated areas. Eighty trapping stations were established within an area of about 4,000 feet in the gulch, where the elevation ran from 400

Dr. Kartman, now medical entomologist with the San Francisco Field Station of the Communicable Disease Center, Public Health Service, was chief of the CDC Hawaiian Field Station during 1951-53. Mr. Lonergan also participated in the study and is now sanitary engineer at the Technical Development Laboratories of the center at Savannah, Ga.

Figure 1. Map of study area in Kaunamano gulch, showing the location of trap sites.



to 750 feet (fig. 1). Each station was supplied with cage traps at 50-foot intervals. The traps were similar to the kind shown in the report by Spencer and Davis (11).

At one time during the work, bait boxes were placed at intervals of 5 stations beginning with station No. 1. Rodent activity at these bait boxes was estimated on the basis of bait con-

sumption (12) and numbers of fecal pellets. The fecal pellets were counted and the boxes were thoroughly cleaned at each visit.

A small part of the work, lasting about 1 1/2 months, was conducted in a field of sugarcane (field No. 1). This consisted of about 103 acres of mature cane at an elevation of from 200 to 900 feet. An area of approximately 40 to

Table 1. The number of new rats live-trapped by months, in Kaunamano gulch¹

Species	1952											
	July			August			September			December		
	Num- ber	Per- cent	Rats per 9 trap- days	Num- ber	Per- cent	Rats per 8 trap- days	Num- ber	Per- cent	Rats per 8 trap- days	Num- ber	Per- cent	Rats per 10 trap- days
<i>Rattus hawaiiensis</i>	33	46.4	3.5	22	56.4	2.6	21	56.7	2.6	40	54.0	4.0
<i>Rattus rattus</i> group ²	36	50.8	4.0	14	36.0	1.7	13	35.2	1.6	23	31.2	2.3
<i>Rattus norvegicus</i>	2	2.8	.2	3	7.6	.3	3	8.1	.3	11	14.8	1.1
Total rats and ratio per trap-days	71	100	7.9	39	100	4.8	37	100	4.6	74	100	7.4

50 acres around the periphery of the field was supplied with 200 cage traps at 35-foot intervals.

The traps were baited either with small coconut squares or small pellets made of commercial dog food mixed with rolled oats and wrapped in waxed paper. Rolled barley or rolled oats was used in the bait boxes in amounts that could not be completely consumed between visits.

In a few cases, traps were modified so that an attached clock would be stopped at the moment the trap trigger was released. By setting the alarm in the morning for 8 p. m., the time of capture could be determined by whether or not the alarm spring had unwound.

Captured rats were anesthetized with ether (rarely with chloroform), marked by toe amputation, combed for ectoparasites, checked for pertinent physical data, and released at the point of capture. The results of blood examinations and body temperature determinations have been published elsewhere (13, 14). Individual record cards were kept for each animal captured.

During the course of the major portion of the study, the rats were subjected to the effects of 10 percent DDT powder in pyrophyllite. During October and November 1952 the main effect of warfarin-poisoned oats was studied. The DDT appeared not to have a noticeable influence upon the rats. The warfarin decimated the commensal rat population, and data during this period have been eliminated for purposes

of the present report, unless otherwise indicated.

The pressure of other work prevented the use of a grid system of trapping and a more extensive study of the rodents in the plague region. Nevertheless, although the methods employed do not give the detailed results desirable in an investigation of rodent ecology, the data represent a definite contribution to the knowledge of rodent behavior in this region inasmuch as little or nothing has been published in this regard.

Results and Discussion

The four species of rodents found in the Hamakua District are: *Rattus rattus* subspecies *R. r. rattus* and *R. r. alexandrinus*; *Rattus norvegicus*; *Rattus hawaiiensis*, and *Mus musculus*. For present purposes, all subspecies of *R. rattus* are considered together and no data are presented on the house mouse. All of these species live wild in the field, but the native rat, *R. hawaiiensis*, is the only truly wild rodent in Hawaii—it lives only in the field and never in human habitation.

The number of rats of each species trapped during each month in Kaunamano gulch is shown in table 1. The predominance of *R. hawaiiensis* and *R. rattus* in this region corroborates a former study (15). The average number of rats of all species per acre in gulch areas of the Hamakua District has been estimated at

Table 1. The number of new rats live-trapped by months, in Kaunamano gulch¹—Continued

Species	1953											
	January			February			March			April		
	Number	Percent	Rats per 5 trap-days	Number	Percent	Rats per 7 trap-days	Number	Percent	Rats per 13 trap-days	Number	Percent	Rats per 14 trap-days
<i>Rattus hawaiiensis</i>	40	76.9	8.0	38	66.6	5.4	109	48.6	8.3	132	55.9	9.4
<i>Rattus rattus</i> group ²	11	21.2	2.2	7	12.2	1.0	96	43.0	7.3	65	27.6	4.6
<i>Rattus norvegicus</i>	1	1.9	.2	12	21.2	1.7	19	8.4	1.4	39	16.5	2.7
Total rats and ratio per trap-days	52	100	10.4	57	100	8.1	224	100	17.2	236	100	16.8

¹ Excludes data for October 1953, when the effects of warfarin poisoning on the *rattus* group population were obvious: *R. hawaiiensis*, 21; *R. rattus* group, 4; *R. norvegicus*, 3.

² *Rattus rattus rattus* and *Rattus rattus alexandrinus*.

between 40-60 (15). Application of the Lincoln index (16)

$$\frac{\text{animals marked in precensus period}}{\text{other animals present in precensus period}} =$$

$$\frac{\text{marked animals trapped in census period}}{\text{other animals trapped in census period}}$$

to some of the data recorded here showed, for example, that the estimated total populations of all rat species in the gulch study area during the periods July-August 1952 and January-February 1953 were respectively, 182 and 223. The actual number of captures of all rat species made during these periods was respectively, 110 and 109.

In another report (12), the commensal rat species, primarily *R. rattus*, were shown to be the predominant populations feeding at the bait boxes. The report also showed that bait consumption could be maintained at an almost constant level in the manner shown by Chitty

for *R. norvegicus* (17). The counting of fecal pellets may also provide a means of determining the population level (fig. 2). The generally greater abundance of small fecal pellets suggests that young individuals predominated among rats feeding in the bait boxes.

Rolled barley was used from the first baiting on May 21 to July 2. During this time the fecal pellet curve rose to a maximum and leveled off. However, on July 3 the bait was changed to rolled oats. This introduced two new factors—a change in the appearance and odor of the food, and a more highly processed food not requiring the time-consuming task of removing the hulls. Thus, many rats may have been shy of the new food for varying periods, and those that fed did not linger in the bait boxes as long as they had when the rolled barley was used. The result was a sharp drop in the fecal pellet curve which began to rise again as more rats adjusted to the new situation.

Figure 2. The number of fecal pellets removed from bait boxes at each visit and the effect of warfarin poisoning on this measure of rat activity.

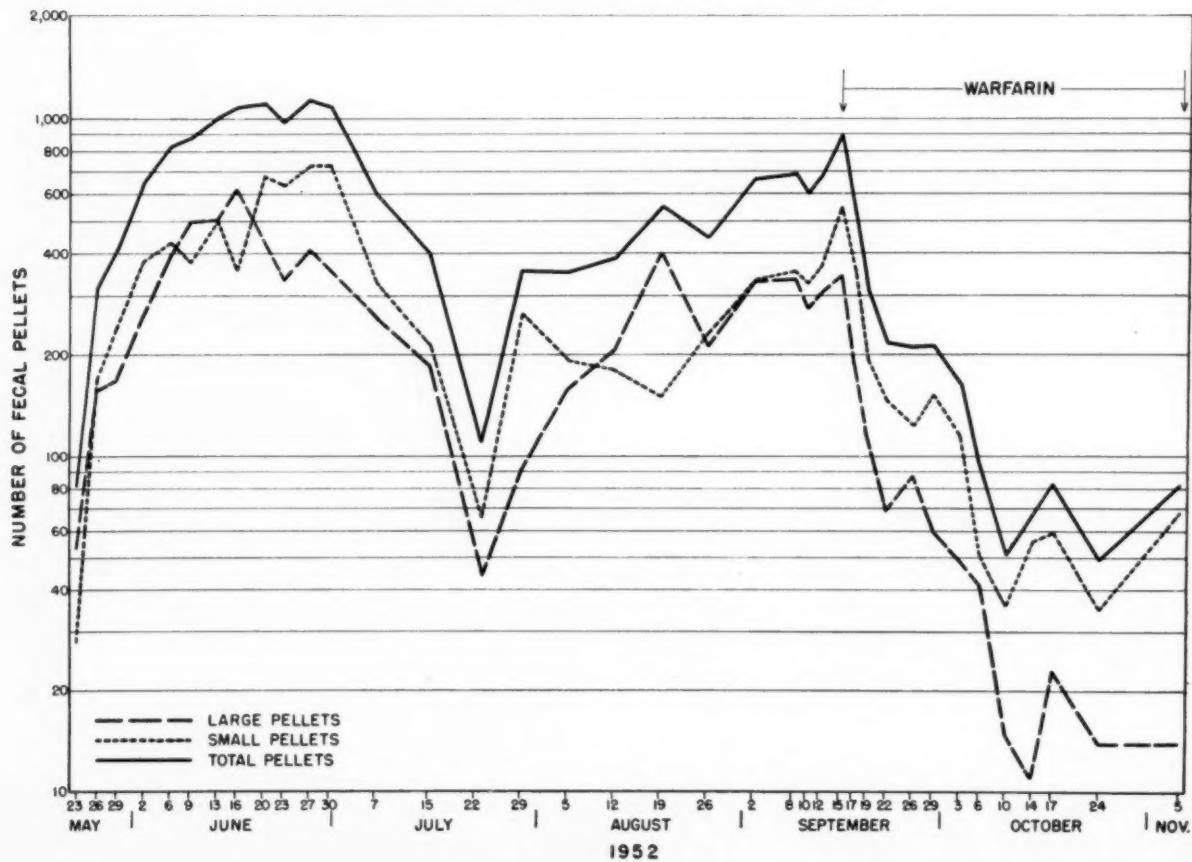


Table 2. Proportion of sexes of live-trapped *Rattus* species

Location	<i>R. hawaiiensis</i>			<i>R. rattus</i> group ¹			<i>R. norvegicus</i>		
	Male	Female	Ratio	Male	Female	Ratio	Male	Female	Ratio
Field No. 1.....	25	28	0.9	25	32	0.8	10	4	2.5
Kaunamano gulch.....	234	222	1.1	136	133	1.0	36	57	.6
Total.....	259	250	1.0	161	165	.9	46	61	.8

¹ *Rattus rattus rattus* and *Rattus rattus alexandrinus*.

On August 11, a harvest of sugarcane in a field adjacent to the study area was initiated and lasted until August 22. This forced new rats into the gulch area, as was indicated by the trapping, and may be partially responsible for the rising curve of fecal pellets.

Finally, the introduction of warfarin-poisoned rolled oats on September 15 produced the second sharp depression in the curve. These considerations suggest that a controlled count of fecal pellets is a fairly sensitive index of a rat population level as it is influenced by various environmental factors.

No significant differences were found in the proportion of the sexes of the three rat species in either of the study areas (table 2). However, the paucity of *R. norvegicus* did not allow a valid comparison for this species.

Some idea of the survival of the rats can be obtained by an analysis of recaptures, or what amounts to the disappearance of retrappable rats over a period of time (18). These data indicate a high probability of disappearance for all three species (table 3). This corroborates findings on the island of Oahu (11). The reasons for the high disappearance rate are obscure and appear to contradict the fairly constant level of bait consumption (12) and rodent activity (fig. 2). Since an equal number of rats disappeared after their initial capture as were recaptured, some difficulty in retrapping appears to have influenced the results. Among the known factors, the inefficiency of individual traps and frequent springing of traps by mice, *M. musculus*, are probably of importance.

In field No. 1, where trapping lasted less than 2 months, almost 50 percent of the traps failed to capture a single rat, whereas captures of rats in Kaunamano gulch were more consistent (fig.

3). Although the establishment of trap-frequenting orientations by rats over a period of time is undoubtedly a factor in trapping success, the ecological difference between the gulch and field also may have been a factor since 100 percent of the stations became active in the gulch area in less than 2 months (12). However, a good deal of variation in success of trapping small mammals has been found to be correlated more with bait attractiveness than with population level (19). Thus, the above factors must be considered in an evaluation of rodent survival and other ecological factors.

The coexistence of several rodent species within the same environmental sector is undoubtedly of prime importance for the maintenance of wild rodent plague (20), and this idea is implicit in the observations of Eskey (21) in his classic study of plague epidemiology in Hawaii. Data published elsewhere have shown that all three rat species in Hawaii may be in-

Table 3. "Survival" of *Rattus* species in Kaunamano gulch¹

Month	<i>R. hawaiiensis</i>	<i>R. rattus</i> group	<i>R. norvegicus</i>	Total
Number recaptured.....	107	58	11	176
1st.....	77	36	7	120
2d.....	16	10	1	27
3d.....	10	8	1	19
4th.....	2	3	1	6
5th.....				
6th.....	1	1	1	3
7th.....				
8th.....				
9th.....	1			1
Not recaptured.....	103	46	23	172

¹ Data exclude rats found dead, rats first captured during the last 2 months of trapping, and non-*hawaiiensis* taken during the poisoning period.

duced to feed in the same bait box and are hosts to the same species of plague vector fleas and trypanosomes (12, 13). These findings are supported by data on the number of times all species of rats were captured in the same trap (fig. 4).

The number of each rat species attracted to any particular trap generally corresponded to the percentage species composition of the different rat populations in the area (table 1). Although thought to be extremely shy (22, 23), the Hawaiian rat predominated in the majority of trap captures. The probability that the time of feeding does not intervene as a limiting factor in this connection is suggested by a few data on the exact time rats were captured. The available records follow:

<i>R. hawaiiensis</i>	<i>R. rattus</i> group		<i>R. norvegicus</i>		
a. m.	p. m.	a. m.	p. m.	a. m.	p. m.
3:30	1:00	3:30	7:45	3:55	
5:17	3:20	4:53	11:30	5:40	
7:10	8:00	5:10	11:40		
	9:50	9:00			
	9:55				

There are enough overlapping times to suggest that many rats of each species undoubtedly seek food in the same area at approximately similar times. Whether or not there is any

serious interspecific competition or whether the more aggressive species are predators on the weaker are factors which have not been determined. All three species of rats were found in very close proximity on the island of Maui, and the possibility of predation by *R. rattus* on *R. hawaiiensis* was suggested (24).

The Hawaiian rat is thought to be the primary wild plague reservoir from which the other species periodically become infected (21, 24). The possible role of the mouse, *M. musculus*, is not known, but this species was consistently taken in the traps and comprised a large population in the study areas. Thus, in the areas studied, there existed a continuous rodent population composed of the four species mentioned.

Other evidence of the stability and sedentary nature of the rodent populations may be obtained by a study of recapture data and movements of the rats. A summary of these observations is presented in table 4 and examples of individual rat movements are given in table 5. The restricted amount of movement shown for all three species of rats is not surprising inasmuch as these animals would tend to live within

Figure 3. Trapping efficiency as shown by frequency of live captures of rats by traps in: A—Field No. 1, and B—Kaunamano gulch.

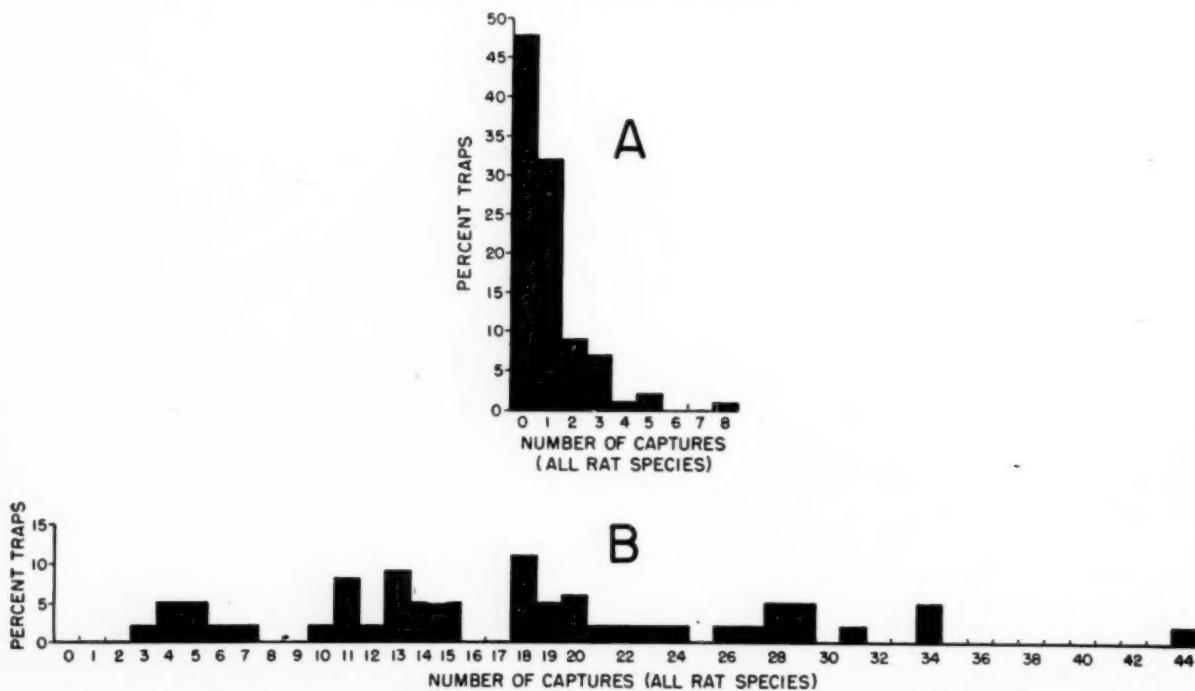
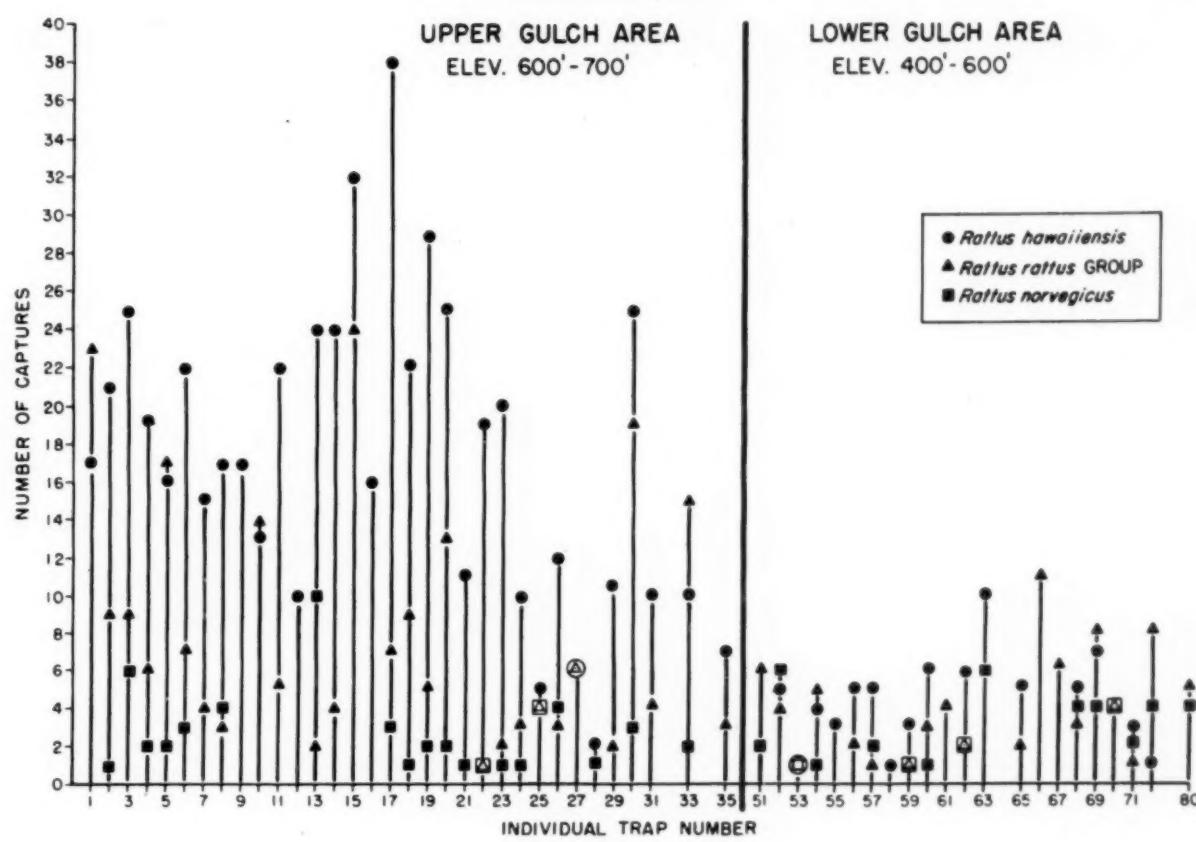


Figure 4. The number of times three species of *Rattus* were captured alive in the same trap in Kaunamano gulch.



a small area until profound environmental change occurred. Thus, the following percentages of captures were made between 0 and 100 feet from the location of the original capture:

	Field No. 1	Kauna-mano gulch
<i>Rattus hawaiiensis</i> -----	74.1	94.6
<i>Rattus rattus</i> group-----	78.2	80.5
<i>Rattus norvegicus</i> -----	28.5	71.4
All spp. (both locations)-----	86.7	

This indicates predominantly exploratory rather than migratory movement. Few extreme movements were recorded. Two exceptions were: rat No. 130, a female *R. r. alexandrinus*, which was recaptured after 5 months 3,450 feet from the place of original capture, and rat No. 155, a male *R. norvegicus*, recaptured after 6 months 1,500 feet from the site of original capture.

It cannot be asserted that these movement data shed light upon the home ranges of the

various rat species since home range is a measure of area. In line with the contentions of Holdenried (25), many of the rat movements recorded here are probably measurements of maximal movement which is thought to represent the longest axis of a home range. It must be borne in mind that these so-called maximal movements are determined within the limits set by the arbitrary spacing of traps. In many cases they are probably only fair approximations of the true maximums.

The observations recorded here suggest that, in the region studied, the three species of rats do not carry out extensive migrations, are more or less sedentary populations, and appear to coexist in an environment which favors their close physical proximity with a minimum of adverse interspecific coaction. These characteristics, together with observations already recorded regarding their ectoparasites and disease relationships (12, 13, 21, 24), appear to favor the perpetuation of wild rodent plague.

Table 4. Summary data of *Rattus* spp. recaptures and movements¹

Type of data	<i>R. hawaiiensis</i>		<i>R. rattus</i> group ²		<i>R. norvegicus</i>		Totals
	Field No. 1	Kaunamano gulch	Field No. 1	Kaunamano gulch	Field No. 1	Kaunamano gulch	
Recapture status							
Rats released	53	215	57	107	14	34	480
Not recaptured	35	111	41	48	11	24	270
Recaptured	18	104	16	59	3	10	210
In more than 1 month	4	67	6	36	1	6	110
Dead in traps	3	5	2	-----	2	1	13
Times recaptured							
Distance (feet) from original capture:							
0	5	120	8	34	-----	4	171
1-49	10	63	6	17	1	3	100
50-99	5	11	4	7	1	3	31
100-149	4	2	2	2	-----	-----	10
150-199	1	-----	1	4	-----	2	8
200-249	-----	1	1	2	1	1	6
250-299	-----	1	-----	2	1	-----	4
300-349	2	2	1	1	-----	-----	6
350-399	-----	2	-----	-----	-----	-----	2
400-449	-----	3	-----	1	1	1	6
450-499	-----	-----	-----	1	1	-----	2
650-699	-----	-----	-----	1	1	-----	2
Total	27	205	23	72	7	14	348

¹ These data include only a portion of the total rats captured (see table 1).

² *Rattus rattus rattus* and *Rattus rattus alexandrinus*.

Table 5. Examples of individual rat movements in Kaunamano gulch

Species and rat No.	Age	Sex	Location ¹ of capture (station No.)											
			1952						1953					
			July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
<i>R. hawaiiensis</i> :														
42	Juvenile	F	23	22	-----	22	-----	-----	-----	-----	-----	-----	-----	-----
1	Adult	F	3	3	-----	3	-----	-----	-----	-----	-----	1	2	-----
70	Juvenile	F	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
152	Adult	M	-----	-----	-----	20	-----	-----	-----	-----	-----	18	18	-----
72	Adult	M	-----	-----	-----	-----	-----	19	19	19	20	20	20	-----
71	Adult	F	-----	-----	-----	-----	15	15	15	17	16	16	16	-----
<i>R. rattus</i> group:														
25	Adult	F	29	30	30	-----	-----	-----	-----	-----	-----	-----	-----	-----
44	Adult	M	15	18	18	-----	-----	-----	-----	-----	-----	-----	-----	-----
16	Adult	M	-----	-----	-----	-----	18	17	-----	-----	-----	17	17	-----
50	Adult	F	-----	-----	-----	-----	14	15	-----	-----	-----	15	15	-----
130	Adult	F	-----	-----	80	-----	-----	-----	-----	-----	11	11	11	-----
<i>R. norvegicus</i> :														
10	Juvenile	F	-----	-----	-----	-----	13	-----	-----	13	-----	-----	-----	-----
17	Juvenile	F	-----	-----	-----	-----	13	-----	-----	-----	-----	17	17	-----
155	Adult	M	-----	-----	6	-----	-----	-----	-----	-----	-----	35	35	-----

¹ See figure 1 for location of station numbers.

Summary

Observations are reported concerning wild rodents inhabiting areas within an enzootic plague region on the island of Hawaii. The rat species *Rattus hawaiiensis*, *Rattus rattus* subspecies, and *Rattus norvegicus* were captured alive, marked, released, and recaptured to gain some idea of their survival, movements, and interrelations. Results suggested that none of the rat species migrates extensively, that they constitute more or less sedentary populations, and that they appear to coexist in an environment which favors their close physical proximity. Thus, in the areas studied, there appears to be a continuous rodent population having characteristics favorable for the perpetuation of wild rodent plague.

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A policy of kindness to patients, established a hundred years ago by the founders of the pioneer Federal mental hospital, survives the test of time and experience.

St. Elizabeths Centennial

By WINFRED OVERHOLSER

THE INSTITUTION known today as St. Elizabeths was established in Washington, D. C., 100 years ago, March 3, 1855, as the Government Hospital for the Insane. The change of names, a consequence of popular usage, is characteristic of a policy which has distinguished its practice since the great humanitarian, Dorothea Lynde Dix, penned the words which Congress approved in the basic legislation: "Its object shall be the most humane care and enlightened curative treatment of the insane of the Army and Navy of the United States, and of the District of Columbia."

The name St. Elizabeths was applied originally by early Maryland settlers to a tract of land which was occupied eventually by the hospital. When a part of the original building, now known as the center building, was used for surgical care of patients from the Union Army, it was called St. Elizabeths Hospital. Patients and staff eventually applied the gentle name to the entire institution. In 1868, Dr. Charles H. Nichols, the hospital's first superintendent, commented on the "happy circumstance that gave this establishment a designation of so much beauty and of such sacred association." In 1916, the Congress made the title official.

In the past 100 years, there have been many

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advances in the care of the mental patient—technical, institutional, administrative, medical, legal, and social advances—with St. Elizabeths often in the forefront. The hospital has been the originator of many contributions to mental health. But its first contribution, the concept of kindness, formulated by Dorothea Dix, remains outstanding.

The atmosphere of kindness earned St. Elizabeths the title of "The Hospital with a Heart," from Sam Stavisky in an article published in Colliers magazine. The patients are given as much latitude as their condition warrants. They experience restraint only when they may injure themselves or others.

The administration of Howard Hall, the maximum security section of the hospital, reflects this policy in a place where it might seem least likely to succeed. The patients there, many of them under criminal charges, are considered to require close observation, yet they successfully conduct a limited form of self-government.

Once a month, the Howard Hall patients participate in an "administrative meeting," conducted by officials other than those engaged in treatment. It offers patients an opportunity to air their opinions and discontent and to have their suggestions and complaints discussed by fellow patients.

These patients also publish their own journal, a mimeographed magazine, edited, illustrated, and duplicated entirely by and written almost exclusively for patients in that hall. Last De-

ember, the *Howard Hall Journal* reprinted from the American Mercury an article, "Medicine is Curing Me of Crime," written by its former editor. An example of a patient's contribution to the *Howard Hall Journal* is the brief statement on the following page, giving a patient's experience with, and reaction to, television programs.

Patients are encouraged to offer administrative suggestions and criticisms in their journal, and these suggestions are carefully reviewed by the superintendent for constructive guidance. This is true also of *The Elizabethan* published by and for patients in other branches of the hospital. Although the superintendent has found and used constructive suggestions in these publications, their pages are relatively free of critical comment.

Other contributions of St. Elizabeths have been reported elsewhere. St. Elizabeths pioneered the use of malaria fever for treatment of paresis, hydrotherapy, the use of a photographic department, pathologic museums as an adjunct of training, a psychological laboratory, forensic psychiatry, and the therapeutic value of the creative arts and crafts including the psychodrama. In 1942, St. Elizabeths was the first public mental hospital to use the psychodrama as developed by Moreno.

St. Elizabeths is today pursuing with high hopes the application of drugs which appear to bring about a therapeutic effect with their ability to quiet and relax the patients. On the other hand, it looks with great skepticism on such drastic therapies as shock treatment and lobotomy.

St. Elizabeths is distinguished, in another sense, by the fact that its chief administrator, the superintendent, has always been a professional psychiatrist. This practice conforms with the principles laid down by Dorothea Dix. The American Psychiatric Association has for years advocated that the administrative head of a mental hospital should be a psychiatrist. Superintendents of St. Elizabeths all have been honored with the presidency of the American Psychiatric Association.

The importance of having a professional psychiatrist at the head of any mental hospital is based on the principle that all details of administration are part of the psychiatric treatment.

The situation is not comparable with that of a general hospital. Every item of finance is subject to consideration by a physician of the effect on medical care of the patients. Although 40 percent of the staff of 2,500 have no direct contact with the patients, all contribute to the patients' welfare and receive some instruction as to behavior whenever they come in touch incidentally with the patients.

St. Elizabeths is a complex of more than 50 principal buildings occupying 360 acres on a hill across the Anacostia River. The view from its parks and porches surveys the Capitol, the Washington Monument, and the memorials to Jefferson and Lincoln. Its facilities include a firehouse, a library, a beauty parlor, several cafeterias, a private railroad for carrying coal to the steam plant, an incinerator, a police and fire department, a laundry, 9 kitchens, and a 400-acre farm a few miles away at Oxon Hill, Md. The assessed value of this property is in the neighborhood of \$18,000,000, although it could not be duplicated for that sum. The new geriatric building alone represents an investment of \$3,500,000.

The hospital population is in the neighborhood of 7,500. The admissions are approximately 1,500 a year; discharges are about 1,000 a year. A majority of the discharged patients leave after a stay of no more than a few months, although one patient recently was discharged as cured after 26 years' residence. Roughly, a fourth of those admitted have been patients in a mental hospital on earlier occasions.

A hundred years ago the official view was that not more than 250 beds should be the capacity of any mental hospital. The original plans for St. Elizabeths called for about 90 beds. But with the growth of the population, St. Elizabeths has reflected the increasing number of patients eligible for admission to St. Elizabeths. As noted originally the hospital was intended to accommodate only personnel from the defense forces and, incidentally, residents of the District of Columbia. Today it is authorized to receive patients from more than 20 sources, including Indian reservations, veterans from the Soldiers' Home, and others in beneficial relation to the Federal Government.

Scientific advancement in the treatment of mental patients has helped to offset the rise in

admissions. Effective treatment and prevention of paresis has reduced the number of patients suffering from that disease from about 6 percent of the admissions to almost zero. In common with other mental hospitals, St. Elizabeths has been receiving an increasing proportion of aged patients. Nearly 40 percent of the hospital's admissions today are persons above 60 years of age.

With the opening this summer of the new Dorothea Lynde Dix Pavilion, an admission and treatment building, there will be greater opportunity for improving diagnosis of patients upon admission. This will permit a greater degree of intense individual attention with the possibility that the patient may be cured and discharged that much more promptly.

In addition to the recognized psychiatric treatment, St. Elizabeths has long been known for its careful attention to the physiological basis of mental illness and for its generally comprehensive interest in patient health. It is the only public mental hospital in the United States which is approved for a rotating internship, in recognition of the high caliber of performance and equipment at its medical and surgical

building. Interns at this hospital do their pediatric and obstetrical and laboratory work at other hospitals.

In appraising the accomplishments of St. Elizabeths, it is difficult to assign credit to any particular technique. Studies of the value of psychotherapy are always difficult to frame. The response of the patient may result from a variety of factors. Although some techniques, such as drug therapy, appear to give a relatively clear-cut basis of evaluation, the complications of the individual personality frustrate most efforts at evaluation of treatment. Intensive attention to the individual is the key to improvement. This conviction dates back to the hospital's report for 1888 which regarded individual attention to the patient as more important than anything else.

No less important than the new diagnostic center, the Dix Pavilion, is the plan for revised and improved statistical methods of analyzing patients on a cohort basis. When this plan is applied, new facts will be ready to aid in the evaluation of mental hospital care. St. Elizabeths is confident that the facts will justify its traditional policy.

The World on a String

A mental patient's views on television are here reprinted with minor editorial change from the journal written and published by residents of Howard Hall, St. Elizabeths Hospital. They illustrate the character of creative expression in the Howard Hall Journal, and they suggest also the opportunity for evaluating the influence of TV programs on mental health, both in and out of the hospital.

This is one of those rare cases where the mountain comes to Mohammed. Only in this instance it is we, the hospital shut-ins, that are unable to go to the mountain, and it really isn't a mountain at all, it's the outer world. To us shut-ins, the world is divided into two parts, our own little isolated inside world and the outer world of people free to pursue their ends. One of the major problems to a shut-in is not that he is a shut-in, but rather that the outer

world is shut out. Perhaps most of us can understand and accept the fact that because of varying degrees of mental illness we are, out of necessity, shut-ins, but what many of us find so difficult to accept and understand is why so much of the outer world is shut out. Fortunately, we are not alone with our problems, for the administrative doctors of Howard Hall are well aware of our dilemma as evidenced by their unceasing efforts to bring to us as

much of the outer world as is practically possible. Certainly they are aware of our psychological need for contact with the outer world. One of the steps taken by the administration has done more to alleviate this situation than all others combined.

They presented us patients with the world on a string. They have brought the outer world, in all its entirety, into our recreational day rooms!

An ordinary, common garden variety electric world is the string that is tied to the world which in turn is encased in a small, square box: a television receiver! With a twist of the wrist and a flip of a dial, the outer world flows to meet our eyes! Mohammed's mountain was mere child's play in comparison with our wondrous little box. Instantaneously we are in the midst of a downtown crowd watching the parade of the Legionnaires, or we are riding in a brand new 1955 auto or watching the sports attraction of the day. There's the news and we are in Korea and then swiftly join a group of firemen in Chicago; then on to Washington for a meeting with the President and his Cabinet. We see the latest fashions and meet the outstanding personalities of the day. All of these things would be impossible were it not for this amazing little box.

One would think that the ability of this small box to bring the outer world to us is miracle enough, but no; it doesn't stop there. It goes beyond just mechanical function. It has dynamic effect on our morale, attitude, and emotions. It assumes a therapeutic role in every sense of the word. The rollicking laughter

that echoes down the hall when favorite comedians perform, the anxiety expression that comes with suspense and the intentness of concentration that comes with drama and quiz show are emotional entertainment. Our miraculous box constantly reminds us that there are comfortable living rooms with families gathered around a dinner table; that there are happy people, situations and circumstances. This serves to jar us out of the "just existing" attitudes and probes and jabs at our slumbering will to get well and "go home." It serves as a deterrent to keep the mind from becoming single tracked or in a rut or as some of us say, "institutionalized."

For it brings to us, at the exact moment, events that are taking place; it expands our isolated little community until it is as vast in scope as is the outer world. To those of us who are convalescing, it helps to prepare us for our return to society. It keeps us abreast of the times and the pulse of things so that when we do reach this outer world it is not a strange and unfamiliar place to adjust to. It gives its viewers a mutual sense of participation and interest. Educationally, its lessons are extensive in that it teaches us and gives plenty of practice in dem-

ocratic relationships with our fellow men. The selection of TV committees, scheduling programs, and the operation of the TV set help form the habit patterns of cooperative group spirit, teaching us to respect the other fellow's opinions, rights, and privileges.

In pausing to consider the significant role TV plays in our shut-in world, one can readily agree that this ingenious little box should never be taken for granted or underestimated. And in realizing the importance of TV, we should also take precautionary measures to insure its continued future use. A deeper sense of responsibility for this "World on a String" should be accepted by us all. We must all adjust ourselves to our neighbors' desires, opinions, and preferences so that all of us may enjoy the benefits of it without infringing upon the rights and privileges of fellow patients. In doing this we not only create more viewing pleasure for ourselves and others but we insure continued performance by our mechanical friend. Most important, it will give all of us practice and experience in getting along in a community of people. It will have its therapeutic effect and this is of primary concern to us shut-ins.

PHS Staff Announcements

Dr. Louis C. McCabe has been appointed staff adviser on air pollution to Mark D. Hollis, Assistant Surgeon General and chief engineer officer of the Public Health Service. Since 1951, Dr. McCabe has been chief of the Fuels and Explosives Division, Bureau of Mines, Department of the Interior. He served for 2 years as director of the Los Angeles County Air Pollution Control District.

Arthur C. Stern, formerly chief industrial hygiene engineer of the New York State Department of Labor, has assumed direction of the Public Health Service program of air pollution research and technical assistance to States and local agencies. He will be stationed at the Robert A. Taft Sanitary Engineering Center, Cincinnati.

The Health Maintenance Clinic Program of the Fife-Hamill Memorial Health Center

By GULDEN MACKMULL, M.D., HYMAN MENDUKE, Ph.D., and JOSEPH J. CAVA, M.D.

A HEALTH maintenance clinic was established in 1948 at the Fife-Hamill Memorial Health Center by the department of preventive medicine of the Jefferson Medical College of Philadelphia.

Persons presumed to be healthy were to be registered at the clinic for periodic physical examination and instruction in health habits and proper hygiene as well as advice on environmental, economic, and personal problems relating to the early detection of health hazards or prodromes of disease.

The existence of the clinic was publicized by local South Philadelphia newspapers, parent-teacher associations, handbills taken home by school children, and by public health nurses.

A comprehensive history and environmental

details were obtained for each individual on his first visit to the clinic. This was followed routinely (1) by a complete physical examination, including pelvic examination in women, a complete blood count, urinalysis, serology for syphilis, stool examination for parasites, and X-ray of the chest. Special laboratory tests were made when indicated. As far as practicable, home visits were made by public health nurses accompanied by senior medical students of the medical college. These contacts permitted a personal appraisal of pertinent environmental factors which influenced the final disposition of cases.

After the initial examination, recommendations concerning the patient were given. If no disorders were discovered, the person was offered advice calculated to help maintain health, and he was urged to return for reexamination, usually within a year. When some disorder was discovered, pertinent suggestions were made, and the individual was referred to his personal physician, hospital clinic, or to an appropriate agency best suited for handling the particular problem.

The time elapsing between the initial and the return visit depended on the individual situation. At most it was a year. At this second examination, recommendations were reiterated, or new advice was offered if necessary. All persons were notified by mail several weeks before the date of the reexamination; notification was frequently repeated by a telephone call the day before the appointment date.

Drs. Mackmull, Menduke, and Cava are closely associated with the Jefferson Medical College of Philadelphia and with the college's health maintenance clinic program at the Fife-Hamill Memorial Health Center. Dr. Mackmull, assistant professor of preventive medicine, is chief of clinic and director of the division of clinical preventive medicine at the center. The associate director, Dr. Cava, is instructor in medicine and clinical assistant in preventive medicine. Dr. Menduke, assistant professor of biostatistics, serves the health maintenance clinic as statistical consultant. The center is located at Seventh and Delancey Streets, Philadelphia.

Area Served by the Clinic

Most of the patients included in this study lived in the section of Philadelphia between Chestnut and Mifflin Streets on the north and south and between the Delaware River and Broad Street on the east and west. This area in southeast Philadelphia has a total population of about 110,000, and the age, sex, and race composition is similar to that of the city as a whole. Roughly four-fifths of the population in both the clinic area and the city are white; the clinic area has, however, a higher proportion of foreign-born individuals, among whom Italians predominate. Approximately two-thirds of the white residents and practically all the non-white residents are financially eligible for the service of the clinic. Eligibility for clinic services is restricted to persons whose annual income is \$3,500, or less.

This part of the city is generally recognized as one of the worst problem areas in Philadelphia. It is characterized by poverty, lack of education, inadequate housing and sanitation, as well as by high morbidity and mortality rates (2-4).

The First Clinic Visit

This report is based on a study of the first 1,500 consecutive patients who made their initial visits to the clinic between September 1948 and February 1953. These patients included 207 white men, 1,050 white women, 29 nonwhite men, and 214 nonwhite women, representing respectively 0.8, 4.1, 0.4, and 2.7 percent of the financially eligible population in each group.

Women predominated in every age group, with highest representation among white women 20 to 49 years old and nonwhite women 12 to 19. In general, individuals 50 years and older were poorly represented in the clinic census.

The individual's motivation for clinic attendance was either asked specifically of each patient or deduced from his history. Despite the admitted unreliability of this method, patients were considered subjectively "ill" if they knew of the existence of a specific illness or sought aid because of definite complaints. They were considered subjectively "well" if no specific complaint was volunteered.

If the individuals' statements can be trusted, almost half believed themselves "well" and actually came for health maintenance. The percentage who considered themselves "well" was slightly higher for white men than for white women and considerably higher for the younger than for the older persons in both racial groups.

The higher proportion of younger individuals in the clinic census who thought they were in good health may be attributed either to health consciousness indoctrinated recently in school or to the fact that young persons are really more healthy. Despite the poor representation of nonwhite persons, nonwhite women, 12 to 19 years of age, had a relatively high representation in the clinic census. A large proportion of this group came to the clinic presumably in good health.

It is not particularly surprising that 97 percent of those who considered themselves ill on the first visit really required medical attention. However, it is highly significant that three-fourths of the presumably well white men and practically all the presumably well women, particularly those 20 years of age and over, were found also to need medical care.

In all, 93 percent of the allegedly well really required treatment. Of all 1,500 patients, only 75, or 5 percent, were found to be free of medical, dental, or mental conditions. But 127 individuals, or 8 percent, could be considered in this category if caries of the teeth and pregnancy were not included as conditions warranting treatment. As was expected, the percentage of persons requiring medical attention was lower for the young than for the old, lower for men than for women, and lower for white than for nonwhite persons.

While the clinic was able to inform 23 persons that they were laboring under a misapprehension in believing themselves to be ill, 655 who thought they were well actually required medical guidance. Hence, there is no question as to whether the health maintenance clinic is fulfilling its purpose in the early detection of disease.

Number of Diseases Per Patient

Commonly a patient requiring medical help suffered from more than a single disorder.

Some had as many as 7. The modal and median number was 2. This was true whether or not dental caries and pregnancy were included. There were only 52 individuals for whom the sole finding was caries or pregnancy, or both. In most cases, caries or pregnancy or both conditions were found in conjunction with other complaints. Including caries and pregnancy, the 1,500 patients reported here accounted for 3,288 medical conditions. If dental caries and pregnancy are excluded from the computation, the number is reduced to 2,906.

Table 1 shows no striking differences either between races or sexes in the incidence of multi-

ple illnesses. There was, however, a disparity between the sexes with respect to the presence or absence of disease: A higher proportion of the men were found healthy. As was anticipated, the incidence of multiple disease increased with the age of the patient. Boys and girls in the 12- to 19-year-old age group tended to have no illness or only one. Adults in the 20- to 49-age group tended to have 1 or 2 disorders and in the 50 and over category 2, 3, or more diseases.

Medical conditions found in the 1,500 individuals are tabulated in table 2. Obviously not all conditions could be itemized separately. Frequency of incidence constituted the main criterion for the compilation of this table, which follows a topographic classification (5).

A wide variety of medical conditions was observed, a substantial number of which were discovered in patients who were unaware of their medical problems.

For example, all cases of cervical erosion, cervical polyps, ovarian cysts (4 patients), cancer (3 patients), hypochromic anemia, intestinal parasites, gastric ulcer, and cholecystitis were diagnosed as a direct result of the efforts of the clinic. In addition, between three-tenths and nine-tenths of all uterine tumors, chronic cystic mastitis, dental conditions, malnutrition, diabetes mellitus, syphilis, hypertension, valvular heart disease, and goiter were presumably unknown to the patient before his first clinic visit.

Although such subdivision into conditions known and unknown to the patient is admittedly subject to error, there is little doubt that without the clinic examination a substantial number of illnesses would have been discovered only at a more advanced stage.

Referrals After First Visit

Although 1,500 persons accounted for 3,288 medical conditions, the number of individual referrals, 2,842, was smaller, since the hospital or family physician, could in many instances take care of more than one complaint (see table 3). The number of referrals ranged from none in the 75 healthy clients to as many as 5 for the patients needing treatment.

For the healthy person a variety of advice

Table 1. Number of illnesses¹ per patient by age, sex, and race in 1,500 patients

Age group and number of illnesses	Percentage of total patients in each age group			
	White		Nonwhite	
	Men	Women	Men	Women
<i>12 to 19 years</i>				
0	41	20	(2)	24
1	37	52	(2)	37
2	22	20	(2)	26
3	0	6	(2)	9
4 to 7	0	2	(2)	4
Total	100	100	-----	100
<i>20 to 49 years</i>				
0	16	5	(2)	6
1	32	30	(2)	34
2	34	35	(2)	26
3	14	20	(2)	25
4 to 7	4	10	(2)	9
Total	100	100	-----	100
<i>50 years and over</i>				
0	12	3	(2)	(2)
1	9	16	(2)	(2)
2	35	33	(2)	(2)
3	26	33	(2)	(2)
4 to 7	18	15	(2)	(2)
Total	100	100	-----	100
<i>All ages</i>				
0	20	5	28	10
1	30	30	24	33
2	32	34	24	26
3	13	21	21	21
4 to 7	5	10	3	10
Total	100	100	100	100

¹ Exclusive of dental caries and pregnancy.

² Percentages not computed when there were fewer than 20 patients.

Table 2. Incidence of medical conditions, in 1,500 patients

Conditions, by topographic classification	Number
Body as a whole	788
Psyche (primarily anxiety states but including 6 psychoses)	338
Body (primarily obesity and malnutrition but including 31 syphilis)	450
Integumentary system	61
Musculoskeletal system	70
Respiratory system	118
Asthma and hay fever	97
Tuberculosis of lungs	17
Bronchiectasis	4
Cardiovascular system	294
Valvular heart disease	136
Hypertension	89
Varicose veins	45
Miscellaneous	24
Hemic and lymphatic systems (all were hypochromic anemias)	304
Digestive system	512
Diseases of teeth and gums, mostly caries	337
Hemorrhoids	70
Hernia	31
Intestinal parasites	27
Duodenal ulcer	20
Chole cystitis	14
Enlarged tonsils	10
Gastric ulcer	3
Urogenital system	899
Urinary, including 162 cystoceles	207
Female genital, including 417 cervical erosions and 122 rectoceles	666
Male genital	26
Endocrine system	121
Menopausal syndrome	45
Goiter	41
Diabetes mellitus	25
Miscellaneous	10
Organs of special sense (eye and ear) ¹	76
Total ²	3,243

¹ Includes only those individuals requiring eye refraction who had never worn eyeglasses before. ² In addition, there were 45 pregnancies for a grand total of 3,288 medical conditions.

was given. He was admonished, for example, to restrict or omit smoking or alcoholic beverages. Suggestions were offered, or actual arrangements were made with various agencies for a more appropriate job. Interviews with schools or special vocational training classes were arranged, and appointments were made

with officials of the Philadelphia Department of Public Assistance for conferences on increased financial aid.

The mode was 2 referrals per patient. The most frequent referrals were those made for services available in hospitals and for consultation with the nutritionist and gynecologist at the health center.

Return Visits

For a health maintenance clinic to be of greatest benefit, it is essential that return visits be made periodically. Therefore, it is of great interest to examine the record of the appointments which were kept or broken during the study period. It is equally important to compare the return attendance of those, the apparently healthy, who were told they did not need treatment with those, found to be ill, who were actually referred to some agency for therapy.

The 75 healthy individuals were given a total of 160 appointments for return visits. Thirty-three of these appointments, 21 percent, were kept, and 23 persons returned at least once.

The 1,425 ill patients received 3,857 appointments and actually kept 1,255, or 32 percent.

These return visits were tabulated through 1953.

It would appear that although neither group was particularly conscientious about keeping appointments for reexamination, the ill patients were somewhat more regular than the healthy. Records often showed that clients

Table 3. Disposition of 1,500 cases

Referred to—	Number	Percent
Health center	2,114	74
Nutritionist	830	29
Gynecologist	699	24
Dentist	268	9
Ophthalmologist	1,242	9
For health maintenance advice only	75	3
Hospitals	2,676	24
Family physicians	30	1
Social agencies	22	1
Total	2,842	100

¹ Includes 30 individuals who had never worn eyeglasses before. ² Primarily clinic referrals but includes 24 referred to psychiatrist.

would miss one appointment but would keep the next appointment. Therefore, an individual who kept an appointment within 2 years of this tabulation (1952 and 1953) was considered as still being served by the clinic. By the same reasoning, anyone failing to keep an appointment for 2 years was presumed to be separated from the clinic.

Obviously, the health maintenance clinic was able to do little for those who never returned for periodic examinations. A total of 37 percent of the healthy and 33 percent of the ill fell into this category. These figures exclude individuals who made their initial visit within 2 years of the termination of this study.

It is encouraging that more than half of the 1,500 individuals are still currently associated with the clinic. The record is somewhat better for the healthy than for the ill—57 percent for the former and 51 percent for the latter.

Of the 23 healthy individuals who were re-examined, only 6, or 26 percent, were found to have remained healthy on every return visit. It is impossible to say from present data whether this is a high or a low percentage. The figure is higher than the 5 percent who were found healthy on the first visit, but the comparison is not a fair one.

Evaluation of Results

Despite the convenient location of the Fife-Hamill Memorial Health Center in a problem area, only a small percentage of the financially eligible population availed itself of the services of the health maintenance clinic. A number of probable reasons for the low attendance can be advanced.

Known, or suspected, presence of illness is a powerful stimulus for an individual to seek medical attention. He accepts, usually without question, the therapeutic measures offered by a hospital outpatient department or by his private physician. On the other hand, a health maintenance clinic offers only a combination of health education, assurance, and personal interest on the part of the staff. Thus, such a program does not sell itself as readily as that of a conventional clinic.

The dental profession has been rather successful with its slogan "See Your Dentist Twice a Year." Well-baby clinics are now firmly estab-

lished. However, a similar program with respect to a "well-adult" clinic has not yet won wide acceptance among the general population or the medical profession. Therefore, before it can hope to succeed, the program offered by an adult health maintenance clinic must be sold and resold to the public over a number of years. One way is to have the public health nurse visit frequently the homes of actual or potential clients in order to explain the importance of periodic physical check-ups. When such contact is reduced or discontinued, the attendance of a health maintenance clinic suffers.

A professionally organized and properly executed health education program is essential for the operation of a health center. Such a program in full operation would enlist more clientele and assure a larger percentage of return visits. Lack of funds alone has prevented the Fife-Hamill Memorial Health Center, in general, and its health maintenance clinic, in particular, from enjoying such a program.

Periodic examinations are essential for a program of health maintenance. The overall number of return visits at the clinic was discouragingly low. Only 1 out of 5 appointments was kept by those healthy on the first visit and 1 out of 3 for those classed as ill on the first visit. Encouraging is the fact that half of all patients returned at least once. An additional 16 percent may yet return since their initial visit was made within the last 2 years.

Such a clinic may attract patients initially through publicity and maintain attendance to some extent through the efforts of the public health nurse. In the long run, however, clinic growth depends on word-of-mouth referrals by satisfied clients. The number of new patients should increase each year. Our program fell short in this respect. During the period covered, the number of new patients each year remained quite constant with an average of approximately 340.

The low attendance of men is difficult to explain. Only 8 of each 1,000 eligible white men came to the clinic, but the rate for white women was 5 times as high. Among nonwhite persons, where preventive medicine is most needed, men were even more poorly represented. Perhaps of importance is the inconvenience of attending the clinic during working hours, despite the fact

that many employers allow employees to attend clinics without loss of pay.

It is quite probable that 26 percent (6 out of 23) is a biased estimate of the proportion of the clinic census who remained healthy on every return visit. An individual who continues to feel well would be no doubt less likely to return than one who becomes aware of symptoms. No control group is currently available for comparison, and we are unaware of available figures for similar programs. In order to draw a proper conclusion, it would be necessary to trace the history of a similar group of healthy people to whom no health maintenance advice was given. In any event, the period covered by this study is quite short.

Early detection of disease, while ordinarily thought of as a correction rather than prevention, is preventive medicine in the sense that more serious developments are forestalled, or their effects are minimized. Medical conditions were discovered in 93 percent of the individuals who thought of themselves as well before examination showed they were not. The clinic seems, therefore, to have fulfilled its secondary role quite satisfactorily since without examination most conditions probably would not have been discovered until a more advanced stage.

Patients requiring treatment were referred to various agencies (table 3) since no therapy was given at the health maintenance clinic. Because financial eligibility for clinic attendance precluded accepting patients whose annual income exceeded \$3,500, it is not surprising that only 30 (1 percent) were referred to private physicians. Utilization of readily available facilities in nearby hospitals has become habitual with many of these families. Individuals requiring nutrition services were referred to the health center nutritionist since practical dietary guidance programs are not usually available in hospitals. The exceptionally large number of gynecologic consultations can be explained by the predominance of women in the child-bearing age (68 percent of the clinic census) and by the routine inclusion of pelvic examinations.

Occasionally, criticism has been made of a health maintenance clinic in that a false sense of security may be given to those not found to be ill. Periodic health examinations are essential if disease is to be discovered in the presymp-

tomatic stage. A false sense of security on the part of the patient is avoidable by including in the recommendations an explanation of the limitations of predictory diagnosis.

Summary and Conclusions

A health maintenance clinic for adults was established at the Fife-Hamill Memorial Health Center, Philadelphia, by the department of preventive medicine of the Jefferson Medical College of Philadelphia. The primary and secondary purposes of the clinic were the maintenance of health and the early detection of disease by means of periodic examinations of presumably healthy adults in the lower income population of the area served. Considered a health problem area, the geographic site served by the clinic is characterized by low levels of education and income, by substandard housing, and by high morbidity and mortality rates.

This study represents an analysis of the first 1,500 consecutive patients who consulted the clinic initially between September 1948 and February 1953. Return visits were tabulated through 1953. These patients represent only a small proportion of the financially eligible population of the area (annual income below \$3,500). White women 20 to 49 years of age predominated in the clinic census.

On the first visit to the clinic, although half of the patients thought of themselves as being well, almost every patient required treatment of some kind.

These 1,500 persons accounted for more than 3,000 conditions with mode and median of 2 per person. Multiplicity of conditions increased with age.

Only 75 persons (5 percent) appeared in good health and required no specific medical treatment.

Roughly half of all patients actually returned at least once for reexamination. An additional 16 percent visited the clinic initially within the past 2 years.

Of 23 healthy patients who were examined 1 or more times, only 6 were found to have remained healthy.

Because of insufficient data and lack of a control group, the role played by this clinic in

the prevention of disease remains equivocal. The success in early detection of disease appears established.

There is need for more concerted effort toward education in health maintenance through cooperation with private practitioners, school and public health agencies, hospitals and clinics, churches, social agencies, employers and other persons interested in public health.

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Legal Note on Procedural Due Process

In *L. A. Darling v. Water Resources Commission*, 67 NW 2d 890, decided January 12, 1955, by the Supreme Court of Michigan, an order of the State commission was held invalid on the ground that the alleged polluters had not been afforded procedural due process.

The record of the "hearing" before the commission covering pollution of underground water disclosed that witnesses were not sworn, that no exhibits were identified, and that the commission relied on materials and data which were not introduced at the hearing and made no findings of fact.

The court said:

"The legislature's right under the police power to regulate the contamination of waters of this State is not in question, but the exercise of such power does not obviate the necessity to recognize the due process clauses of our State and Federal Constitutions. When the legislature created a 7-man commission, composed of 4 State officials and 3 citizens, it undoubtedly expected it to conduct a proper and legal hearing before issuing an order, such as was issued in this case, that appellant change its method of doing business at an expenditure of a large sum of money.

"The legislature provided for an appeal from the decision and order of the commission to the circuit court and that said appeal would be determined in chancery as a trial *de novo*. This provision did not obviate the necessity of a proper legal hearing before the commission. It did not contemplate that the failure of the commission to hold a proper hearing should be corrected by appeal. The legislature gave to the court the right and duty to pass judgment upon the decision and order of the commission based on the record of such proceedings before said commission."

When exposed to running sea water, the clam uses its own filtering system to cleanse itself of sewage bacteria ingested in polluted waters. How this is accomplished was demonstrated in a series of experiments conducted by the Shellfish Sanitation Laboratory.

Self-Purification of the Soft Clam *Mya arenaria*

By WILLIAM ARCISZ and C. B. KELLY

DURING the past decade the supplies of the soft clam, *Mya arenaria*, have become seriously depleted. Attempts made by biologists (1) to increase clam populations to their former abundance by establishing clam farms and reseeding depleted areas have met with little or no success. However, large supplies of clams in areas which are polluted with domestic sewage are available.

The possibility of ridding shellfish of undesirable bacteria has been given some attention ever since epidemiological evidence indicated that shellfish from waters subject to fecal pollution were responsible for enteric disease (2). That polluted shellfish can be made safe for human consumption by the process of purification has been adequately demonstrated by Fabre-Domergue (3), Wells (4), and Dodgson (5).

Purification is a mechanical process effected

by the physiological functioning of the shellfish in clean water. When shellfish are feeding, the gills act as a filter to strain out some of the material that may be brought in by the water which passes through them. If this water contains sewage, some of the micro-organisms in it are entrapped in the mucus on the body of the shellfish and transferred to the alimentary tract. Some of these are perhaps utilized as food (6) and the others discharged from the body in the form of feces and pseudofeces. When shellfish from polluted water are placed in clean water, the sewage bacteria are eliminated from the shellfish, and, since no more are ingested, purification is accomplished.

Two purification processes, based on the ability of shellfish to cleanse themselves, have been evolved:

Natural purification or relaying. Shellfish from polluted areas are transplanted into clean waters and allowed to purify themselves. This method of natural purification is widely used in the oyster industry. However, many biological factors combine to make it generally infeasible for use with soft clams.

Artificial purification or cleansing. Shellfish from polluted areas are placed in tanks which are filled with water that has been sterilized by filtration, chlorination, or by ozone. The water

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may be drawn and replaced or recirculated after sterilization. The shellfish are kept in these tanks until purified. Cleansing of polluted clams has been practiced in Massachusetts for a number of years (2, 7).

Investigations by Galtsoff (8), Sandholzer (9), Dodgson (5), and others (10) have shown that shellfish are extremely sensitive to chlorine, slight amounts slowing down or completely inhibiting molluscan physiological processes. The Public Health Service Shellfish Sanitation Laboratory at its Woods Hole, Mass., location therefore undertook the investigation of purification rates of soft clams, using clean sea water obtained from a normally pollution-free source. The source of this water was Great Harbor, a sheltered continuation of Vineyard Sound, in Woods Hole, Mass.

Biological Activity of the Clam

The biological activities of the clam are of particular importance in considering pollution and purification of this species of shellfish.

The clam lives in burrows on the marine bottom between the high-water mark and as far as the 40-fathom mark. Although a substantial quantity of clams are taken in 1 to 2 fathoms of water, the bulk of the commercially available supply is obtained from the intertidal zone, that is, between the high- and low-water marks.

The clam obtains its food from the overlying water. Buried in the soil, the clam extrudes its "neck" which contains two connected tubes, the inhalant and exhalant siphons. The water which enters the inhalant siphon flows into the mantle chamber, passes through the basketlike gills and thence out of the exhalant siphon.

In addition to the function of respiration, the gills of the clam are used for food collecting. The gill filaments are lined with microscopic cilia which strain out minute forms of animal and plant life which serve the clam as food. These minute forms, when caught by the cilia, are bound together with mucus and normally transported by ciliary action to the edge of the gills and thence to the mouth by way of the labial palps. After passing through the stomach and intestine, the fecal material is extruded near the inner opening of the exhalant siphon through which it is discharged into the water.

The clam can protect itself from taking extraneous or noxious matter into its stomach. It can either close its siphon, or, if the noxious matter has entered the siphon, expel it by forcibly ejecting the matter as pseudofeces out of the inhalant siphon; or it can transport noxious matter by ciliary action away from the palps and thrust it out of the mantle at the pedal opening.

In view of this, it is quite obvious that the bacterial content of a clam is dependent on the bacterial density of the water in which the clam is resident and to a large degree on the amount of water the clam passes through itself. No data are available as to the exact amounts of water a clam filters in 24 hours. However, the work of Galtsoff (11), Loosanoff (12), and others indicates that, although there are individual differences in animals, an oyster may pass a maximum of 3.9 liters to a maximum of 20 liters per hour under normal conditions.

Temperature of the surrounding water plays an important role as to the amount of water an oyster or quahog will filter. Observations of Galtsoff (13) and Loosanoff (14) indicate that oysters become almost inactive at 6° C., or below. In contrast, the work of Belding (15) and Marston (16) demonstrates that clams are active and will "drink" for considerable periods at a water temperature below 39° F. (3.9° C.).

An important aid to sanitation is the fact that, just as the clam ingests bacteria, so, if placed in pure water, it will eventually free itself from bacteria. The question of primary interest is: How long does this take?

In order to answer this question, two series of experiments were conducted. The first of these experiments was made to determine the role of water pumping activity of the clam on purification. The second series of experiments was made to determine whether temperature of the water had any effect on the purification rate of clams.

Water Pumping Activity

The amount of water pumped through a shellfish is a factor in how rapidly an animal can be polluted and, conversely, how rapidly it can be purified. Unfortunately, no adequate methods are available for measuring the amount

of water which the clam can pump through itself. Insertion of tubes into the inhalant and exhalant siphons by surgical means for the purpose of measuring water flow, although feasible, is not satisfactory, since the ciliary action of these apertures is disturbed.

The carmine cone method of Galtsoff (17) and the cornmeal method used by Dodgson (5) and by Marston (16), which can be used to indicate pumping, were not considered suitable for use in our experiments. Since it is not feasible to measure quantitatively the amounts of water pumped through a clam, the most practical index of pumping activity appeared to be "openness" or "closedness" of the inhalant and exhalant siphons. For our purposes, an animal was considered to be pumping when its inhalant and exhalant siphons were open, and not pumping when both these orifices were closed.

It can be pointed out that this method may not be an accurate measure of pumping activity, if an analogy with measurement of pumping activity of oysters by the use of shell movement is made. Kymograph records, using "shell movement" as a measure of pumping activity, would indicate the passage of large volumes of water through an animal. However, observations of Loosanoff and Engle (18) on feeding of oysters, indicated that, under unfavorable conditions (heavy concentrations of organisms in the water), there was no correlation between the amount of water pumped and the kymograph record of shell movement. In their studies, they used the rubber dam technique of Nelson (19) by which the amount of water passed through an oyster can be accurately measured.

In our experiments, clams of 2½ to 3 inches in length were obtained from a commercial source and placed in an upright position in numbered, gridded trays, containing 98 to 144 animals. After being exposed to polluted water for 3 to 6 days, the clams in the trays were brought into the laboratory and washed with clean sea water. The trays were then placed into a wooden aquarium containing flowing sea water which was kept at all times 3 inches higher than the uppermost portion of the clam shells.

At 15-minute intervals the clams were ob-

served for activity, which was noted as active or inactive. Owing to the sporadic activity of individual clams, it was difficult to obtain "lots" of shellfish which were 100 percent "active" and 100 percent "inactive" for any protracted length of time. Therefore, for sampling purposes, it was found necessary to class clams showing the least activity as inactive and clams which showed the least inactivity as active samples.

The average results of two clam purification runs conducted at temperatures from 17.5° C. (63.5° F.) to 18° C. (66° F.) are illustrated in figure 1.

It can be seen that coliform content of the more active animals is reduced more rapidly than that of the less active animals for the first 5 hours. However, it can be noted that after the 5th hour the "active" clams became progressively less active and the "inactive" clams conversely became more active, so that at the end of 14 hours the "active" group was inactive for 2½ hours and the "inactive" group had been active for 3 hours. This probably explains the fluctuations in the coliform content of the "active" and "inactive" clams from the 5th to the 14th hour. In the 14 hours of observation, there was enough activity even among the less active animals to effect a significant reduction of bacteria.

Temperature Effect on Purification

Marston (16) has shown that *Mya arenaria* can actively feed at water temperatures below 39° F. (3.9° C.) and even at 35° F. (1.7° C.), and that it can ingest bacteria as readily at 37° F. (2.8° C.) as at 73° F. (22.8° C.).

Studies soon to be published, conducted by the Shellfish Sanitation Laboratory, in which the rates of accumulation of pollution in oysters (*Crassostrea virginica*), quahogs (*Venus mercenaria*), and clams (*Mya arenaria*) were studied, show that there is a correlation between the amount of pollution accumulated and the temperature.

In view of these observations, a series of six experiments was conducted at Woods Hole during 1952 and 1953 to determine whether temperature had the same effect on the purification rate of clams as it did on their pollution.

Escherichia coli was chosen as the representa-

tive coliform organism. Since no data are available on the rates of cleansing of enteric pathogens from clams, *Salmonella schottmuelleri* was chosen as a representative of this group. *S. schottmuelleri* proved to be an excellent indicator organism for these studies, since our purification waters, usually of excellent bacterial quality, were occasionally subject to coliform pollution.

These studies were conducted in a small-scale purification plant (fig. 2). Clams from a commercial source, measuring between 2½ to 3 inches in length, were placed in heavy wire trays supported by 2-inch metal legs. Fifty clams were placed in each tray. Four trays were then placed in a wooden aquarium containing a wooden dam. The capacity of the aquarium was 200 liters of sea water, maintained at a height of 3 inches over the uppermost portions of the clam shells. The clams were held in this aquarium for a 48-hour acclimatization period

during which they were continuously bathed with flowing sea water. Dead and weak animals were removed and replaced with healthy ones during this period of time.

At the beginning of each experiment the aquarium was drained and accumulated detritus on the clams and in the aquarium flushed out by a gentle hosing with sea water. The trays of clams were removed, and the aquarium was refilled with 200 liters of sea water. Bacterial suspensions of *E. coli* and *S. schottmuelleri*, calculated to give the overlying water a density of 10,000 *E. coli* and 1,000 *S. schottmuelleri* per 100 milliliters, were added. After a thorough mixing of the water, the 4 trays containing a total of 200 animals were placed in the aquarium. The animals were allowed to "drink" the polluted water for a period of 6 to 10 hours. The aquarium was drained and the shellfish placed in enamelware buckets and stored overnight. The aquarium and trays used in the

Figure 1. Effect of activity on reduction of coliforms in active and inactive clams. Numbers in parentheses indicate time in hours active or inactive.

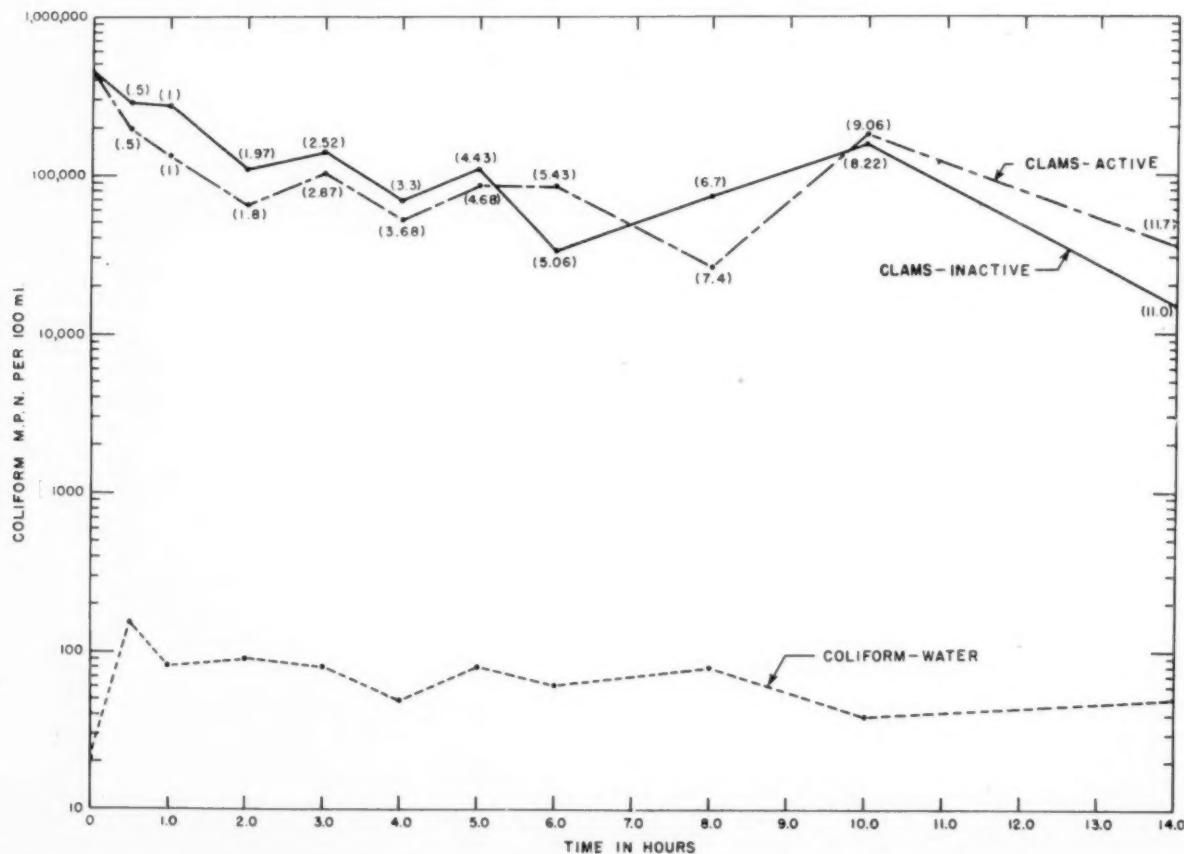
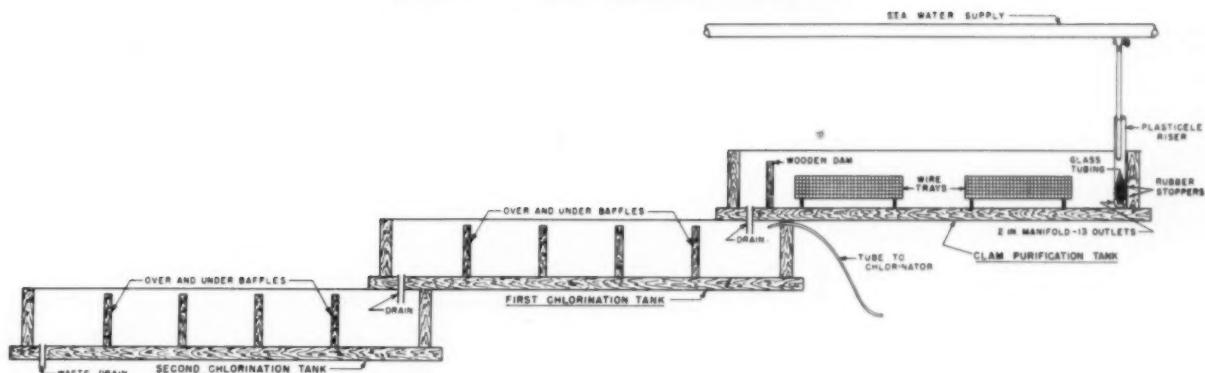


Figure 2. Pilot clam purification plant.



pollution were sterilized for 1 hour with chlorinated water maintained at 100 p.p.m. residual. The sterilized material was then rinsed by flowing sea water for a period of 18 hours.

After overnight storage at room temperature, the clams were replaced in the wire trays and immersed in the aquarium. The rate of flow of sea water was adjusted to 200 liters per hour, or 1 liter per animal per hour. This flow of water was maintained for the duration of the experiment.

To insure that no viable salmonella would be discharged into the receiving harbor, the effluent water from the purification tank was chlorinated by a solution-feed hypochlorinator. Sufficient chlorine was applied to produce a residual of at least 10 parts per million after a detention time of 2 hours in a series of 2 baffled, effluent treatment tanks.

With the exception of a few minor modifications, the bacteriological methods used for the examination of clams and water were those recommended by the American Public Health Association (20). Quantitative estimation of bacterial densities was conducted by the dilution method in which at least 4 decimal dilutions—5 tubes for each dilution—were used.

The method for enumerating *S. schottmuelleri* involved enrichment in Galton's (21) modification of Kauffman's brilliant green tetrathionate broth, with isolation of typical colonies from brilliant green agar. The test was completed by confirmation on Russell's double sugar agar, with occasional confirmation serologically, using salmonella group B antiserum.

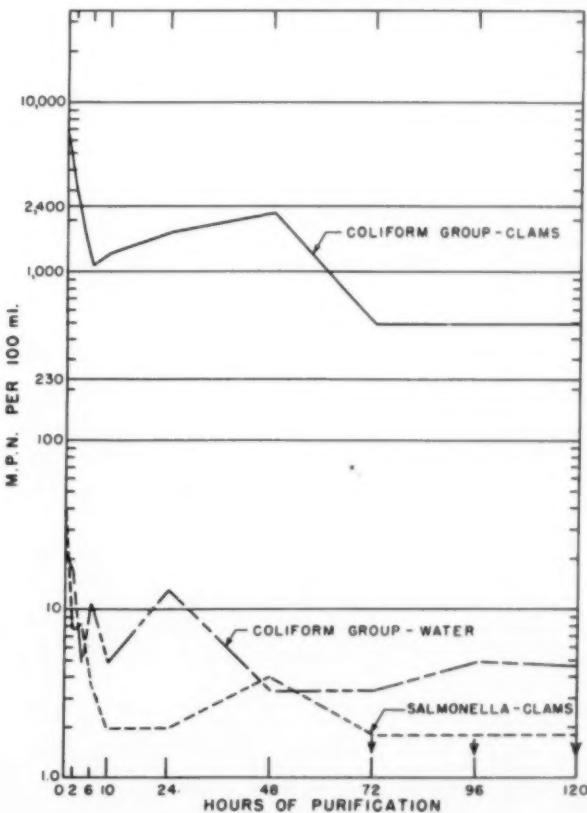
The test for enumerating coliforms consisted

of preliminary plantings in lactose broth, with confirmation in brilliant green lactose bile broth.

Results of tests for both organisms were expressed as most probable numbers (MPN) per 100 milliliters, according to Hoskin's tables (22).

Samples of clams and overlying waters were

Figure 3. Purification of soft clams—Experiment 1. Water temperature range 2.5–4° C.



taken at designated intervals and examined for the presence of coliforms and salmonellae. Sampling was terminated when two consecutive samples showed the absence of salmonellae in the lowest dilution planted.

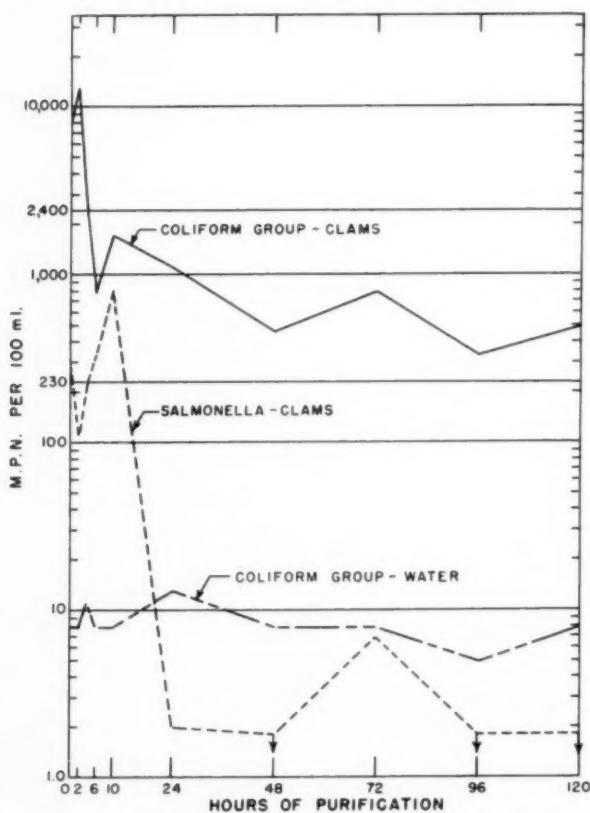
Results of Experiments

The results of these experiments are presented in a series of six figures.

Figures 3 and 4 show the results of experiments conducted at water temperature ranges of 2.5° – 4.0° C. (36.5° – 39.2° F.) and 3.5° – 4.5° C. (38.3° – 40.1° F.).

Figures 5, 6, 7, and 8 give the results at temperatures of 13° C. (54.5° F.), 15° C. (59.0° F.), 18° C. (64.4° F.), and 20° C. (68.0° F.), respectively.

Figure 4. Purification of soft clams—Experiment 2. Water temperature range 3.5 – 4.5° C.



Figures 3 and 4, illustrating the reaction of clams to purification at low temperatures, indicate that the reduction of coliforms in both experiments is similar. There is a similarity in

the rapid initial drop and the subsequent leveling off. Although the initial concentration of *S. schottmuelleri* is roughly 10 times less in experiment 1 than in experiment 2, the time required for complete purging of this organism is 3 and 4 days, respectively.

Figure 5. Purification of soft clams—Experiment 3. Water temperature 13° C.

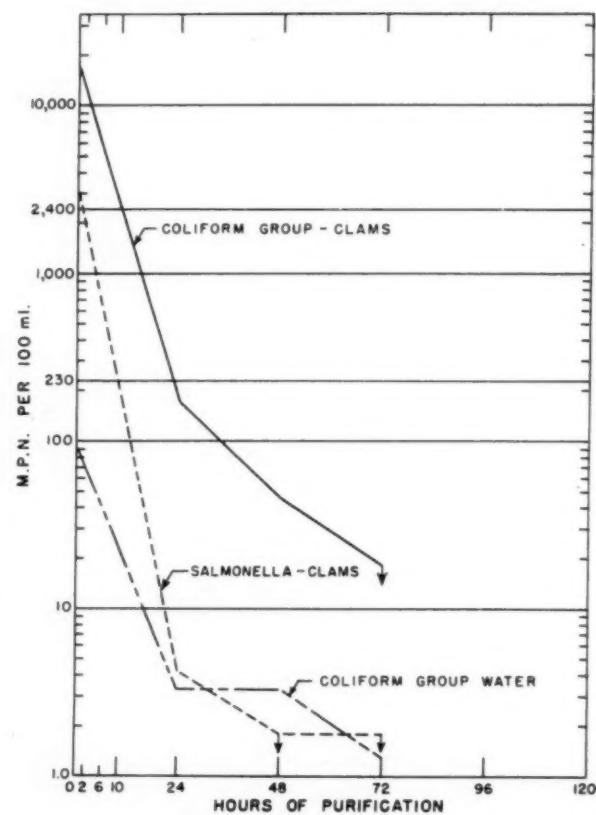
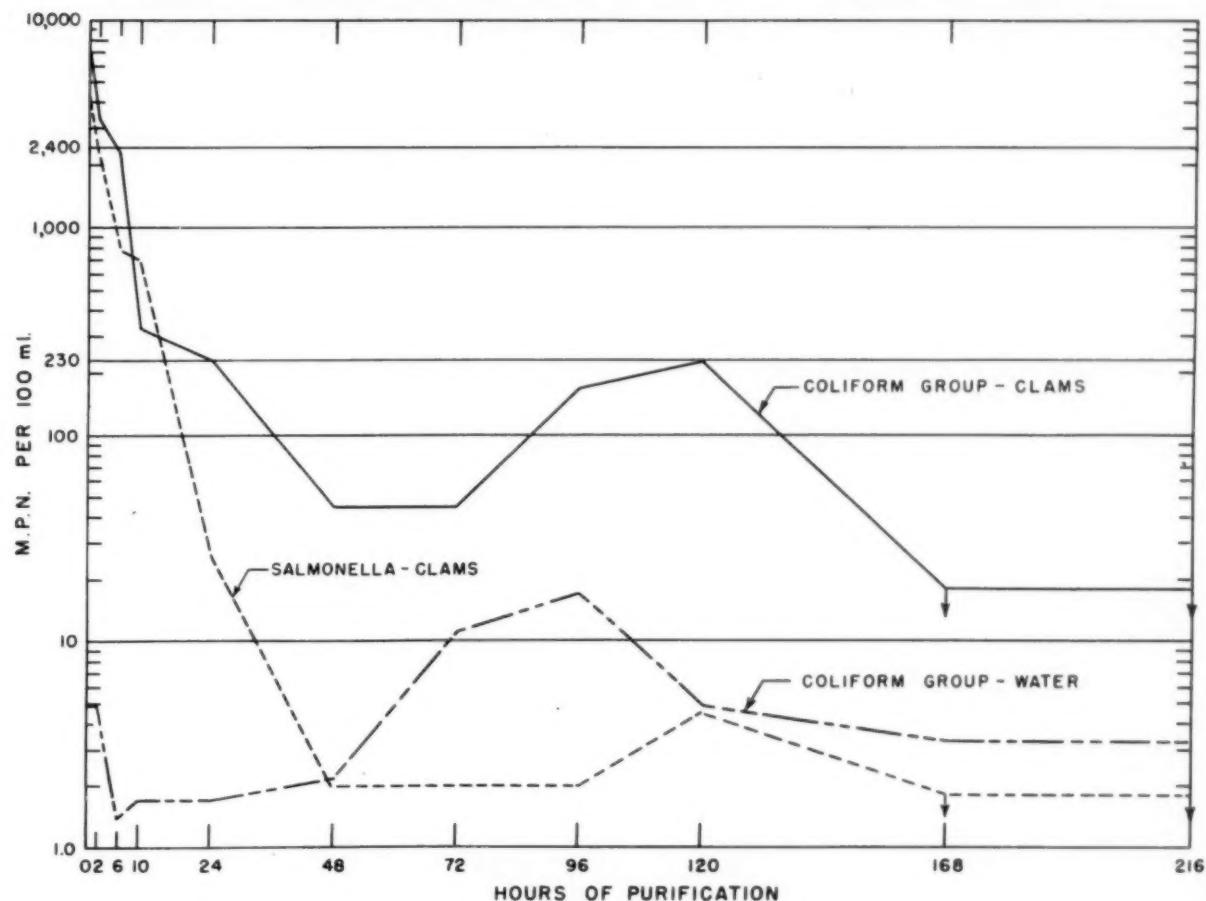


Figure 5 shows that at 13° C. clams containing an initial concentration of 17,000 coliforms and 3,300 *S. schottmuelleri* were purged of the latter in 2 days. No explanation for the indeterminate level of less than 18 coliforms per 100 milliliters which was effected in 3 days can be made, in view of other experiments in which the coliform content of the water was generally low, other than perhaps the clams were more active during this experiment.

Figure 6 shows the results of an experiment in which there were no apparent differences in the physical or biological quality of the water from that illustrated in figure 5, other than a 2-degree rise in temperature. Animals containing an initial concentration of 7,900 coliforms

Figure 6. Purification of soft clams—Experiment 4. Water temperature 15° C.



and 4,600 salmonellae per 100 milliliters showed a rapid decrease of both organisms. However, the clams showed presence of salmonellae for 5 days. Complete purging occurred between the 5th and 7th days.

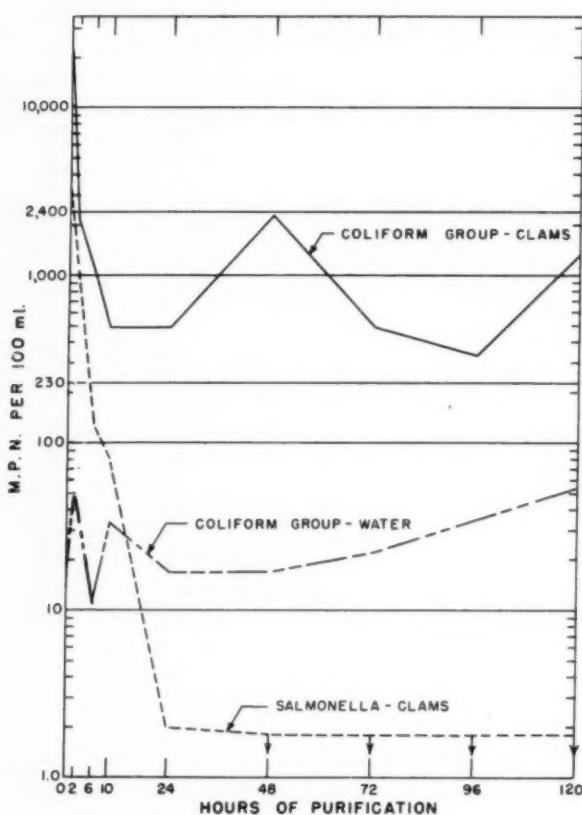
Figure 7 shows that clams having an initial concentration of 22,500 coliforms and 3,300 salmonellae were purged of salmonellae in 48 hours. The coliform content decreased but fluctuated with the water coliform content.

Figure 8 illustrates the effect of occasional pollution of an otherwise satisfactory water supply. Clams containing an initial concentration of 33,000 coliforms and 6.1 salmonellae per 100 milliliters were rid of the salmonellae in 24 hours. Although a reduction of coliforms in the clams did occur, it is not as rapid or as great in magnitude as that occurring in experiments in which the coliform load of the purifying water was lower.

Discussion

The data which have been presented in this report demonstrate that contaminated clams can be purified by exposure to a continuous flow of clean sea water. There is a suggestion that the activity of the clams may play a part in the length of time required for purification. However, even the least active animals studied showed significant decreases in bacterial loads within the purification time employed in the usual clam treatment processes. It is also apparent that the clam can purify itself as effectively at 2.5° C. (34.5° F.) as it can at 20° C. (68° F.). The initial concentrations of polluting organisms used appear to have no influence so far as the length of time necessary for purification is concerned. That enteric pathogens, as represented by *S. schottmuelleri*, can be purged from contaminated clams has been adequately demonstrated. However, although these

Figure 7. Purification of soft clams—Experiment 5. Water temperature 18° C.



data indicate that purification is feasible, a discussion of certain regulatory, economic, and esthetic aspects of clam purification is indicated.

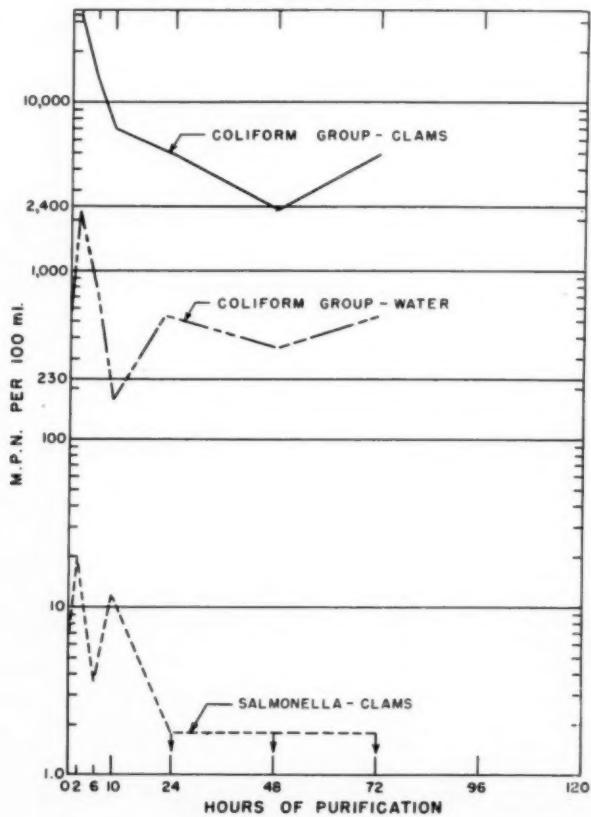
The use of water containing a chlorine residual of 0.05 p.p.m., or more, for purification of shellfish (23) is not supported by the findings of Dodgson (5), Galtsoff (8), Sandholzer (9), nor of the Massachusetts Special Commission Investigating Shellfish Purification (10), which demonstrated that chlorine, even in small amounts, can interfere with or inhibit molluscan physiological processes.

During our experiments, the coliform content of polluted clams usually was reduced to, or below, the recommended limiting coliform MPN of 2,400 per 100 milliliters (23) in 24 hours or less. Because this level of purification was accomplished with water of low coliform content, there is little doubt that using a water of drinking water quality, as recommended in the Public Health Service manual (23), a coliform MPN considerably less than 2,400 could be at-

tained. *S. schottmuelleri* was usually present in the clams in substantial numbers at the time the limiting coliform value was attained. However, at 24 hours and thereafter, *S. schottmuelleri* was irregularly present and only in small numbers at low and medium temperature purifications. Whether the demonstration of these salmonellae at irregular times after 24 hours' purification was due to recontamination of the clams with organisms retained in the experimental apparatus or whether the salmonellae were continuously resident in the animals cannot be determined at this time, and therefore the sanitary significance of their presence is in question.

The economic aspects of shellfish purification are a limiting factor. Finding a source of pollution-free water near areas where polluted clams are found is somewhat of a problem. In most instances, natural waters close to areas where polluted clams are found are not suitable for purification purposes without preliminary

Figure 8. Purification of soft clams—Experiment 6. Water temperature 20° C.



sterilization. This is true in Massachusetts, where clam purification is being practiced at this time. Even if pollution-free waters are found, sporadic pollution of these waters makes the use of naturally clean waters unfeasible for purification purposes. Data gathered at Woods Hole have shown that waters of excellent bacterial quality are on occasion subject to sporadic pollution which can only be related to aquatic birds or runoff from terrestrial sources. However, the problem of finding a pollution-free source of water has been remedied at Conway, England, where water sterilized by chlorine and then dechlorinated has been used with considerable success for purifying mussels.

The efficacy of purification has been questioned from an esthetic viewpoint. It has been compared with dirty milk, containing large numbers of bacteria, which has been pasteurized.

Referring to mussel purification, Dodgson (5) states:

"The analogy between purification of polluted shellfish with the pasteurization of dirty milk would appear to be unsound. In the case of dirty milk, although pathogenic bacteria are, or should be killed by the process of pasteurization, nothing is actually abstracted from the milk, the 'dirt,' of whatever nature, e. g., faecal matter, and so forth—remaining therein. In other words, the milk remains a dirty food. In the case of mussels, however, the whole of the solid matter which they may contain in the intestines or elsewhere, e. g., faecal matter of sewage origin, etc., is eliminated by the shellfish, and got rid of by hosing."

Summary and Conclusions

Polluted clams can be purified by exposure to running sea water of low coliform content, according to experiments conducted at the Public Health Service Shellfish Sanitation Laboratory, when it was located at Woods Hole, Mass.

Activity of the clam may play a part in the length of time required for purification. However, even the least active animals studied showed significant decreases in bacterial loads within the purification time employed in the usual clam treatment processes.

The clam is able to function and purify itself at water temperatures of 2.5° C. (34.5° F.) to 20° C. (68° F.).

The recommended coliform MPN of 2,400 per 100 milliliters for cleansed clams can usually be attained in 24 hours or less.

It has not been determined whether the few *Salmonella schottmuelleri* irregularly observed after 24 hours' purification were derived from organisms in the experimental apparatus and water or from those retained in the animal bodies.

Purification time was not materially influenced by the initial pollution loads in the clams used in these studies.

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PHS films

Fundamentals of the Human Blood Groups

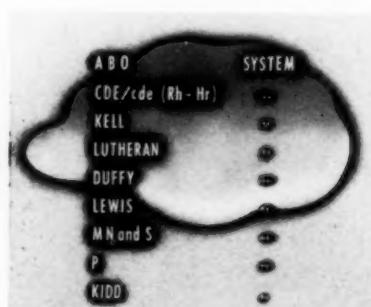
35 mm. filmstrip, sound, color, 15 minutes, 70 frames. 1954.

Audience: Pathologists, laboratory technicians, nurses, medical students, and physicians.

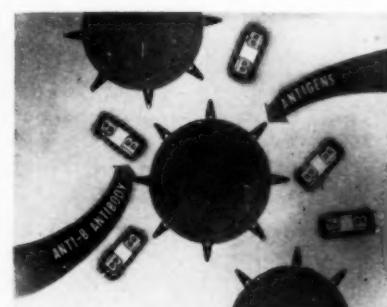
Available: Loan—Public Health Service, Communicable Disease Center, 50 7th St., NE, Atlanta 5, Ga. Purchase—United World Films, Inc., 1445 Park Ave., New York 29, N. Y.

The fundamentals of blood typing are explained by symbols and stylized drawings in this filmstrip

The genetics of blood groups and the incompatibility of the various groups together with a description of "sensitization" are features depicted. Precautions in giving transfusions are emphasized.



All these blood group systems are inherited in a simple Mendelian manner.



The serum of the B group individual always contains anti-A antibodies.

technical publications

Comprehensive Dental Care in a Group Practice

Public Health Service Publication No. 395. 1954. 48 pages. 25 cents.

Presented is a study of time and service requirements for giving complete dental care on a fee-for-service basis to patients who were members of Group Health Association, Inc., a prepayment medical care program in Washington, D. C.

In the study group were 1,925 persons of all age groups, including approximately equal numbers of males and females. Participation of individual patients during the 5-year period of the study averaged approximately 25 months. Initially each participant received treatment for all accrued needs and was subsequently sustained in a state of good dental health by periodic maintenance care.

United States Participation in International Health

Public Health Service Publication No. 416. 1954. 24 pages; illustrated.

Through charts and explanatory notes, this pamphlet illustrates the role of the United States in the improvement of world health conditions. The United States has been concerned with health problems in other countries since 1902, when it participated in the development of the Pan American Sanitary Bureau. In 1942, the United States embarked upon its first bilateral technical assistance programs through the Institute of Inter-American Affairs. These programs are now conducted by the Foreign Operations Administration with the Public Health Service, through its Division of International Health, providing active support to the health components of the program.

The FOA-PHS health program is active in 38 countries in underde-

veloped areas, and its activities cover a wide spectrum. Primary emphasis is placed on training nationals and on controlling malaria, smallpox, yaws, and gastroenteric and parasitic diseases.

The pamphlet also describes the activities of the World Health Organization and the relationship of the Public Health Service to the participation of the United States in this international organization.

State Mental Health Programs Planned for Fiscal 1954 and 1955

Public Health Service Publication No. 374. 1954. 37 pages. 30 cents.

Presented is a cross-section view of how the national health program is being advanced in the States. In addition to abstracts of State mental health program plans, it summarizes major needs and administrative problems pertinent to such programs. Included is a State by State listing which identifies the responsible administrative unit designated by each State as its mental health authority. The text is based on information supplied by the States.

It's Good Business to Know Your Men

Public Health Service Publication No. 379. 1954. 12 pages; illustrated. 10 cents.

Mental health in industry is the subject of this new publication, which suggests how the foreman or supervisor can help to foster a healthy job environment for his workmen by understanding and applying basic mental health principles. It also suggests that he, as a key person, can best help the worker who has emotional problems by using tact and understanding rather than play-

ing the role of "amateur psychiatrist." Since the mental health of a person depends to a great extent on how he gets along in the work situation, the booklet is designed for both management and labor.

An Industrial Waste Guide to the Meat Industry

Public Health Service Publication No. 386. 1954. Prepared by the Committee on Meat Packing Plant Waste Disposal of the American Meat Institute in cooperation with the National Technical Task Committee on Industrial Wastes and the Public Health Service. 12 pages. 15 cents.

Industrial wastes which cannot be eliminated must be disposed of in a suitable manner to protect the Nation's water resources. This pamphlet discusses the sources, quantity, and character of meat industry wastes, the water pollution these wastes can cause, and remedial measures for the control of meat industry pollutants. It is designed primarily as a practical guide for operating and design personnel within the industry itself.

This publication is a revision of the original guide prepared in 1943 by the Public Health Service and published in supplement D of the report, Ohio River Pollution Control. It is the second of a series of industrial waste guides prepared by the National Technical Task Committee in cooperation with the Public Health Service, as a part of the joint government-industry program to reduce water pollution through control of industrial wastes.

How to Study Nursing Activities in a Patient Unit

Public Health Service Publication No. 370. 1954. 48 pages. 25 cents.

How much nurses' time is being diverted from patients to details that other personnel can do? This manual gives a method hospitals can use to study the time distribution of all nursing personnel assigned

technical publications

to inpatient units. The method is similar to that described in the published manual dealing with the head nurse, entitled "The Head Nurse Looks at Her Job." The new manual is intended to help hospital administrators with the next logical step—gathering the information needed to plan better staffing of inpatient units—with the hope that it will save them the time required to devise their own study methods.

The method provides for a sampling of the activities of personnel every 15 minutes. It will provide reliable information on the activities that take the most time and a general picture of the kinds of activities performed by each category of personnel.

Prenatal Health Examination Legislation—Analysis and Compilation of State Laws

Public Health Service Publication No. 369. 1954. 55 pages. 25 cents.

The Venereal Disease Program of the Public Health Service has compiled the laws requiring prenatal blood tests for syphilis which are now in effect in 42 States and 3 Territories. This publication reproduces these laws from the various legal reference sources of the States and Territories and includes citations for these sources.

In addition, the pamphlet contains a table showing the approval and effective dates of prenatal laws for each of the included States and Territories. It also reprints a paper entitled "Prenatal Health Examination Legislation—History and Analysis," by Laura M. Halse and Dominic V. Liberti. The original of the paper appeared in the February 1954 issue of *Public Health Reports*, pp. 105-110.

At the time the publication went to press, Alabama, the District of

Columbia, Maryland, Minnesota, Mississippi, Tennessee, Wisconsin, and Puerto Rico did not have prenatal laws requiring blood tests for syphilis.

Handbook on Sanitation of Vessel Construction

Public Health Service Publication No. 393. 1954. 70 pages; illustrated. 30 cents.

Superseding "Principles of Sanitation Applicable to the Construction of New Vessels" dated June 1949, this handbook contains the minimum public health standards relating to the general sanitation and ratproofing of new vessels and vessels undergoing major reconstruction.

Included in the text are standards for the construction of potable water systems, wash water systems, overboard water systems, pressure water connections, food service spaces, plumbing, swimming pools, and crew and passenger accommodations.

The publication is prepared especially for the use of naval architects, shipbuilders, vessel-operating companies, the industries supplying materials and equipment for vessels, and others interested in sanitation aboard ship.

Occupational Health and Safety Legislation

Public Health Service Publication No. 357. 315 pages. \$1.25.

Intended as a source of legislative reference, this compilation consists of citations and excerpts or digests of laws and regulations dealing with occupational health and safety. It represents a comprehensive revision of a multilithed publication entitled, "Industrial Health Legislation—a

Compilation of State Laws and Regulations," which was issued in limited quantity in 1950.

The present publication includes laws enacted up to and during the first half of 1953. Information on safety inspection and prevention of accidents has been included because lack of uniformity in the usage, coverage, and interpretation of such general terms as "health," "safety," and "sanitation" made it impossible to draw a sharp line of demarcation. No attempt has been made to evaluate the adequacy or effectiveness of the various provisions.

Pertinent information is given for all 48 States, the District of Columbia, Alaska, and Hawaii.

Laws dealing with selected aspects of worker health and safety were examined for the following State agencies: departments of health, labor, industrial relations, agriculture, and education; industrial accident commissions; bureaus and inspectors of mines; public utilities commissions; and a few others, such as State fire marshals for laws regulating health and safety in dry-cleaning establishments.

Selected subjects covered in the provisions include the following: authority and functions of agencies, general provisions relating to occupational health and safety, employment of women and minors, mines and mining, reporting of occupational diseases and injuries, workmen's compensation, vocational rehabilitation, and air pollution and nuisance control.

This section carries announcements of all new Public Health Service publications and of selected new publications on health topics prepared by other Federal Government agencies.

Publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Public Health Service, Washington 25, D. C.

The Public Health Service does not supply publications issued by other agencies.
